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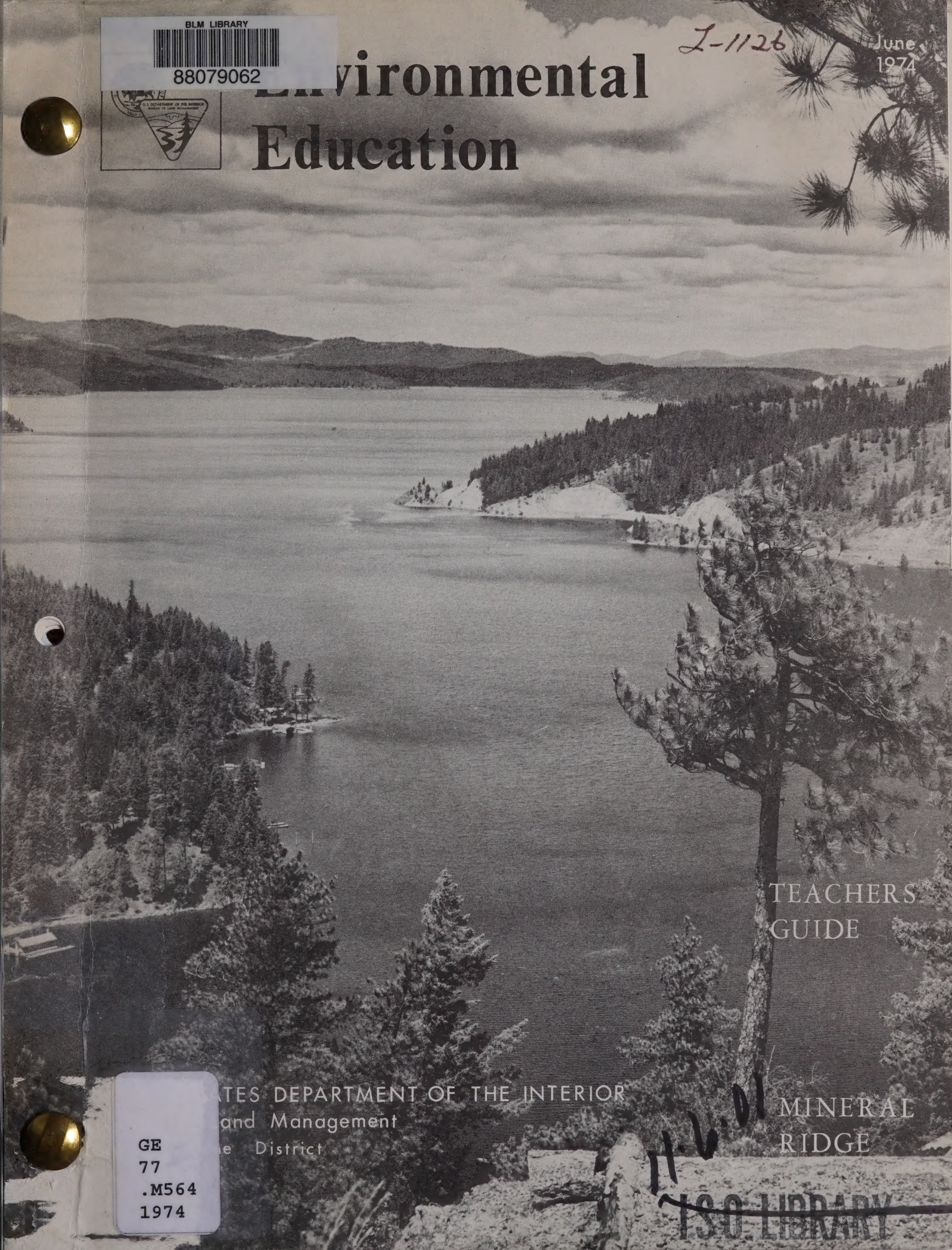

TEACHERS
GUIDE

ATES DEPARTMENT OF THE INTERIOR
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MINERAL
RIDGE

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States-now and in the future.

The Bureau of Land Management, an agency of the Department of the Interior, is charged with the administration of programs for conservation and development of the public lands and resources. In Idaho there are six Bureau of Land Management districts with offices in Shoshone, Coeur d'Alene, Boise, Burley, Idaho Falls and Salmon.

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FOREWARD

The knowledge and principals of conservation have been expressed since the early Chinese philosophers. But these principles have never been fully accepted and practiced in total by the peoples of the world.

The need for environmental education is urgent. The task of awakening the American public to this need is one of the greatest and most immediate responsibilities of the Bureau of Land Management. The care, development and use of the total resources of our nation have been entrusted to the people,

as individuals,

and as a society.

The manner in which this responsibility is recognized and accepted depends largely upon the ability of educators to develop an awareness in their students so that they may become informed.

In 1964, the Bureau of Land Management dedicated the Mineral Ridge area as a natural and scenic area. It was designed for the use and enjoyment of everyone.

This environmental guide handbook suggests approaches to teaching conservation as an integral part of various subject matter areas at the 1 through 12 level of education. It does not suggest that all of the material included be required or used nor does it restrict the teaching of concepts to those included. The material is designed for teacher, not student use.

The Bureau believes that environmental education must identify development as much as it does protection and that it must emphasize far-sighted, knowledgeable use of resources. Environmental education is a continuous process and its success rests on understanding, assistance and action. It is hoped that through this guide the teachers will share this belief and will be stimulated to improve instructional procedures so as to provide experiences for their students which will create a future public with a concern for their environment.,

Special thanks in the production of this guide go to Cheryl Jenkins, an intern student from the College of Idaho.

CREDITS

Credit is hereby given to the following publications for material that has been excerpted and used in this handbook:

People in Their Environment, Outdoor Laboratory. J. G. Ferguson Publishing Company, 1968

"Project Cards" Lander Conservation Center for Creative Learning, 1972.

Trees, Examining Your Environment. Holt, Rinehart and Winston of Canada, Limited, 1972

1973 University of Idaho Environmental Workshop Handbook.

You Are An Environment, Published by the Center for Curriculum Design, 1972.

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INTRODUCTION TO MINERAL RIDGE SCENIC AREA

The teaching stations "staked out" on the Mineral Ridge Trail were chosen as aids to help the teacher illustrate to the students the many facets of our environment. However, the teacher need not feel bound to use the stations - they are provided only as a guide in teaching environmentally. Any of the stations can be skipped at any point along the nature trail.

This first section contains:

Description of the Teaching Stations

Guide to Plants in the Area

The balance of the Handbook is designed to supply further information in the specific areas relating to the teaching stations and suggest projects for each area.

The following is a list of Nature Trail stations:

Station 1 (Teaching Station) Forest Insects: This station shows the damage which is done to Ponderosa Pine trees after they were attacked by the Western Pine Beetle.

Station 2 (Teaching Station) Forest Soils: A soil pit is located here to show the soil profile in a dry Ponderosa Pine forest site.

Station 3 (Teaching Station) Wind Damage: Several trees as this station have been wind thrown and one tree has its roots well exposed for showing root growth.

Station 4 (Teaching Station) Rotten Log: This is evidently the rotten log which Schwecke mentioned in his report. It appears to be excellent for a discussion of the processes that take place as a log reverts back into the forest floor.

Station 5 (Teaching Station) Witch's Broom: Three large Douglas Fir trees located below the trail show a good example of the deforming of trees by mistletoe to produce the "witch's broom" effect on the branches.

Station 6 (Teaching or Information Station) Oldest Tree: A very large Ponderosa Pine is located about 60 feet uphill from the station stake. It is estimated to be 465 years old and is possibly the oldest tree on Mineral Ridge.

Station 7 (Teaching Station) Totem Snag: Fire has carved this snag to resemble a totem pole.

Station 8 (Teaching or Information Station) Wolf Tree: A very large, limby Douglas Fir is located along the trail across from the Mineral Ridge M & M Company sign is designated as a "wolf tree."

Station 9 (Teaching Station) Abandoned Mine: This mine is a good example of a hard rock mining operation and from the appearance of the ore, lead and silver may have been mined here.

Station 10 (Information Station) Second Oldest Tree: This Ponderosa Pine is perhaps the second oldest tree on Mineral Ridge.

Station 11 (Teaching Station) Forest Insects and Parasites: A dead tree about 20 feet below the trail is an example of how mistletoe has weakened the tree to allow Western Pine Beetles to invade it and ultimately cause it to die. Woodpeckers and other birds have worked it over severely while feeding on the insects.

Station 12 (Rest Station) Caribou Cabin: The cabin area could be used to hold "rap sessions" to discuss or review some of the material covered on the trail and to serve as a rest stop.

Station 13 (Information Station) Mineral Exploration Sign: The sign is near a discovery pit or "miners' diggins." Sign explains "diggins" briefly.

Station 14 (Teaching Station) Gray Wolf Watershed Resources Overlook: From this overlook, participants can get a good view of the Blue Creek drainage which serves as an excellent example of a typical watershed.

Station 15 (Information Station) Forest Parasites: Ponderosa Pine trees in the general area have been heavily infected and grotesquely deformed by dwarf mistletoe.

Station 16(Information Station) Miner's Diggins: These "diggins" are a good example of what appears to be an exploration pit or the beginnings of a hard rock mine.

Station 17 (Information Station) How Old Are These Trees?: This station is below Silver Tip Viewpoint just as trail enters a stand or 3-5" DBH trees.

Station 18 (Information Station) Tree Ages: The trees here are identified and aged so that they can be compared with the ages guessed by the participants.

Station 19 (Information Station) Porcupine Damage: Porcupine damage is evident on a tree about 30 feet below the trail. Damage is three fourths of the way up the tree. This is the last station.

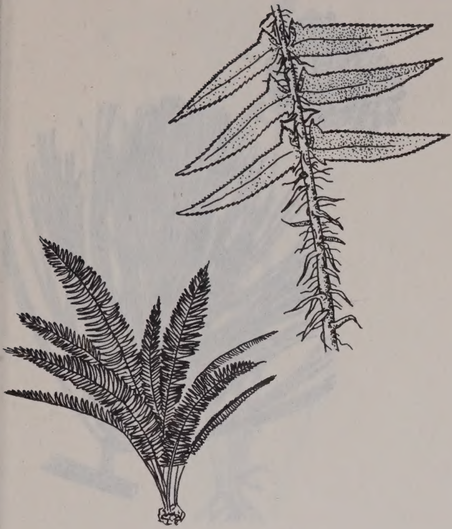
Four stations were staked on the Wilson Trail, but it appears that there is a potential for additional stations. The stations identified to date are:

Station 1, Forest Parasites and Insects: The pine tree at this station is a good example of a tree which was weakened by mistletoe and ultimately killed by Western Pine Beetles. Pines in the general area show a direct correlation between mistletoe damage and susceptibility to beetle attack.

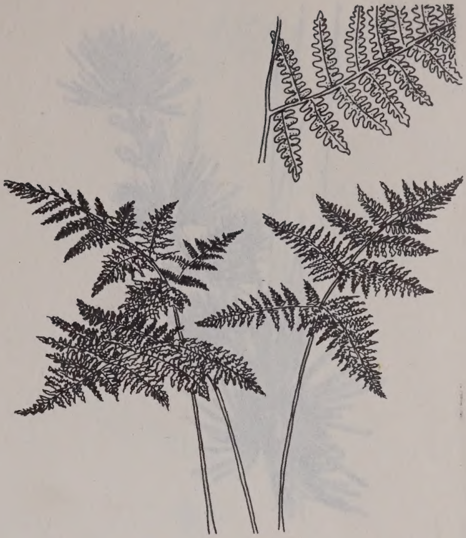
Station 2, Forest Insects: These large trees have been attacked by the larch casebearer. Repeated attacks by these insects will weaken the trees and make them susceptible to attack by bark beetles and other insects.

Station 3, Forest Soils: Soil profile of a moist Douglas fir site.

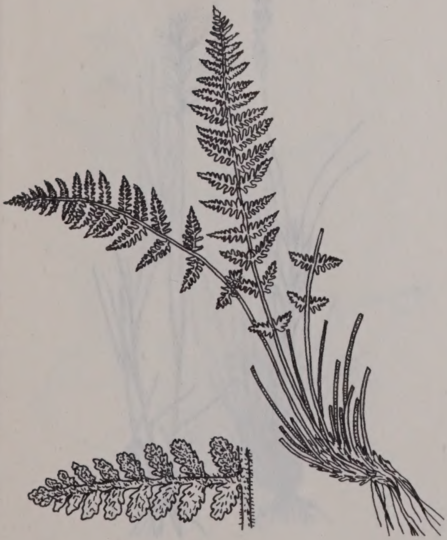
Station 4, Forest Insects: The Grand Firs which have been killed on each side of the trail have been attacked by the fir engraver. These trees show excellent examples of the egg and feeding galleries. Good teaching station.



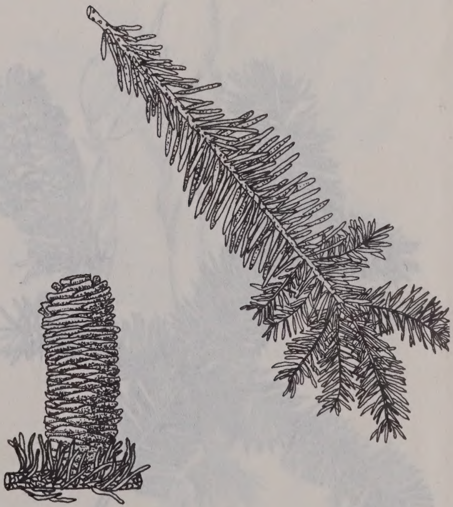
SWORD FERN (Polystichum munitum) A common fern in moist and shady places in the woods. Of no apparent value as food for livestock or people.



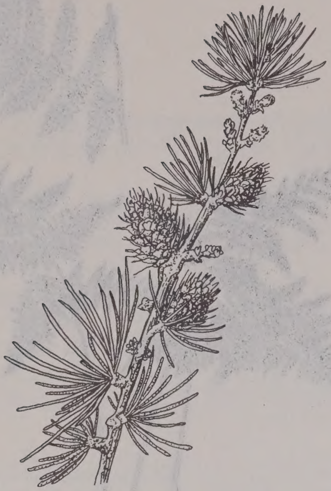
BRACKEN FERN (Pteridium aquilinum var. pubescens) A common fern in moist mountainous areas. In an emergency all parts of the fern can be used for food, though none of it is very flavorful. The Japanese make confectioner's starch from the roots and the Indians dried and stored the curling fronds for food.



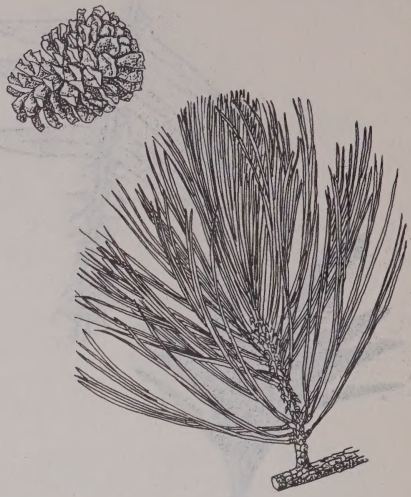
MOUNTAIN WOOD FERN (Woodsia scopulina) Look in cliff areas and around rocks for this little fern plant (up to a foot high). It is of no value to livestock.



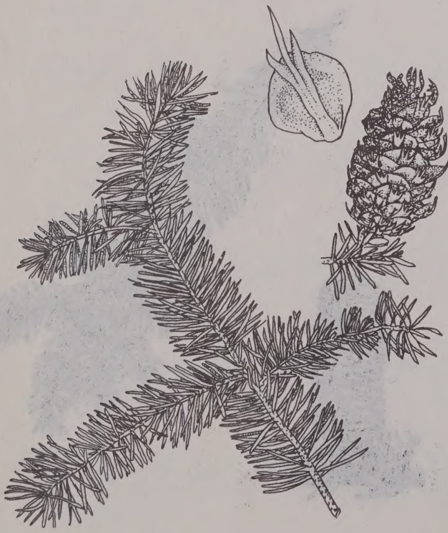
GRAND FIR (Abies grandis) Found on the north side of Mineral Ridge. Look for cones growing upright on tops of branches on this true fir. You won't find the cones on the ground since they come apart as they ripen.



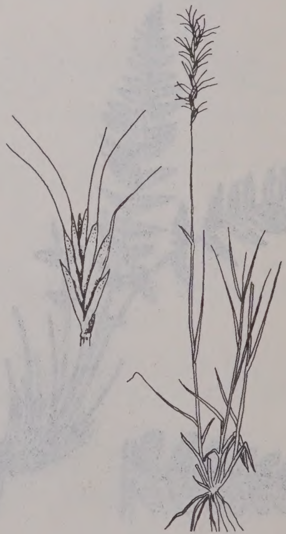
WESTERN LARCH (Larix occidentalis) Also called tamarack. It is one of the two or three cone-bearing trees that drops its needles in the fall. What may look like dead trees in some forests are actually larches. It is a valued timber tree and is attacked by an insect called the "larch case bearer".



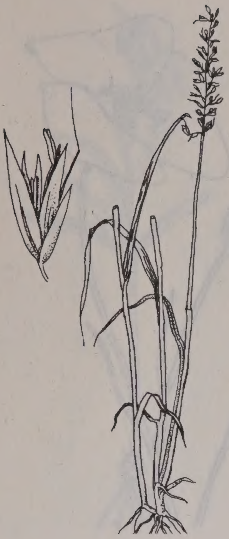
PONDEROSA PINE (Pinus ponderosa) Also called western yellow pine, yellow pine, black pine, bull pine, and perhaps others. The most widespread of any member of the pine family. On some of the older trees on Mineral Ridge perhaps you can detect a vanilla odor in the bark crevices. The second most important timber tree in the west.



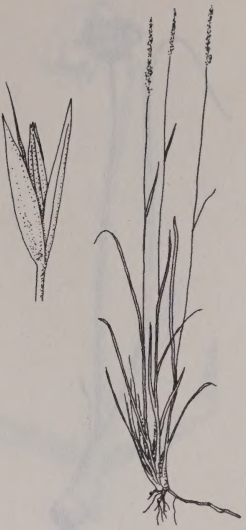
DOUGLAS FIR (Psuedotsuga menziesii) Also called red fir, red spruce, and Douglas spruce. It used to be sold in lumber yards as "Oregon pine." It is the most important timber tree in the world.



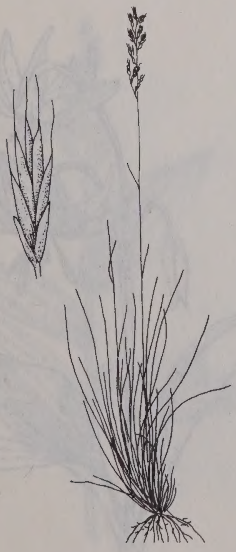
BLUEBUNCH WHEATGRASS (Agropyron spicatum) With Idaho Fescue, one of the two very important grasses in the Palouse Prairie which covers a good portion of the Inland Empire. It is a highly palatable grass for wildlife and livestock. It is a member of a group of grasses called bunchgrasses.



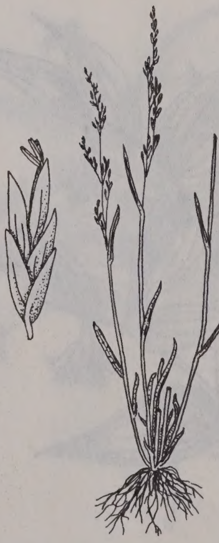
TALL OAT GRASS (Arrhenatherum elatius) This is a slender grass that is up to three or five feet in height. It is not a native but was brought from Europe to be used as a meadow grass. It is now part of our flora.



PINE GRASS (Calamagrostis rubescens) A weak-stemmed slender grass found growing in open woods. It is of minimum value for livestock. Look for a reddish hue in the flowering heads.

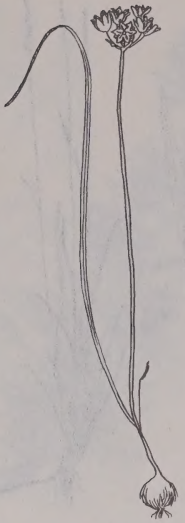


IDAHO FESCUE (Festuca idahoensis) Found in close association with bluebunch wheatgrass throughout the Inland Empire. It is a very palatable and important range grass throughout the intermountain area. It is also a bunchgrass.

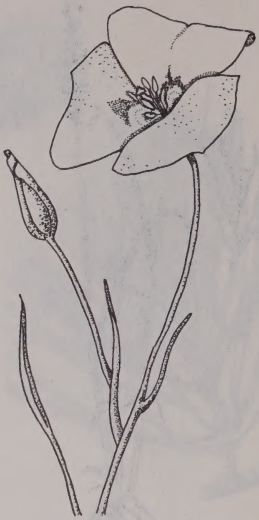


BLUEGRASS (Poa spp.*) Very slender grasses with narrow blades and tiny flowers numerous in fairly large heads. A very important forage species.

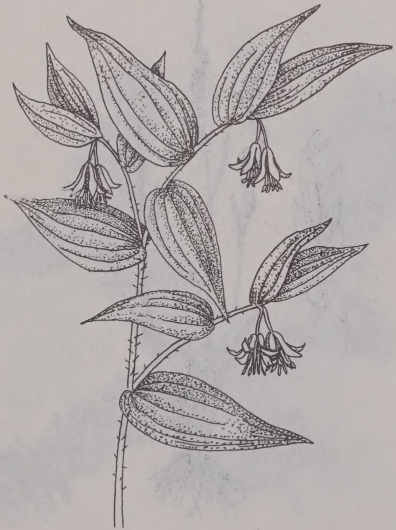
*Note: The abbr. "spp." is a term used to designate a large group of similar plants within one genus.



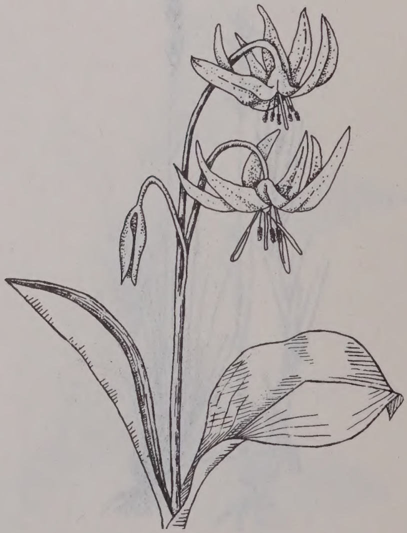
WILD HYACINTH (Brodiaea hyacinthina) White, waxy flowers atop long, fragile stems (6" to 18"). Leaves insignificant. Blue flowered forms (B. douglasii) may also be present. Plant is a member of the lily family and its latin name "Brodiaea" is often used as the common name.



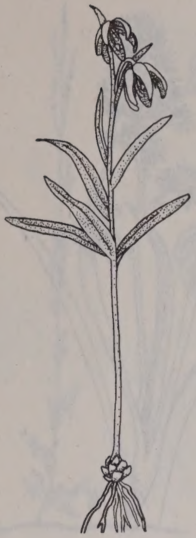
SEGO LILY (Calochortus elegans) The Utah State flower. It blooms in May and has three satin smooth white petals with patches of yellow and maroon in the base. Its starchy bulb is credited with saving many pioneers from starvation. Some others died because they mistook Deathcamas bulbs for those of Sego Lily.



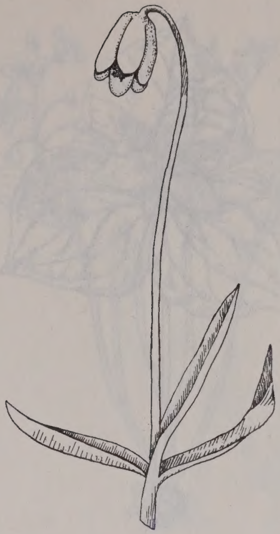
FAIRYBELLS (Disporum hookeri) A leafy stemmed member of the lily family. Look for the distinctive way in which the plant branches by twos. The sparse plant has scarlet berries. Of no significant value as a forage plant.



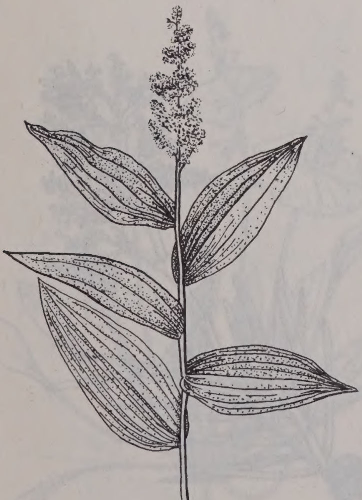
DOG-TOOTH VIOLET (Erythronium grandiflorum) Grows in wooded areas and blooms right after the snow melts. Each plant has two smooth tender leaves with a waxy surface. The flowers are yellow or sometimes white. It has a delicate fragrance.



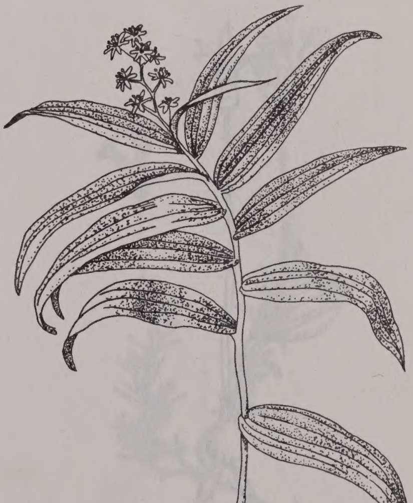
RICE-ROOT (Fritillaria lanceolata) A purple-flowering member of the lily family. It is not very abundant and is also of no particular value as a forage plant.



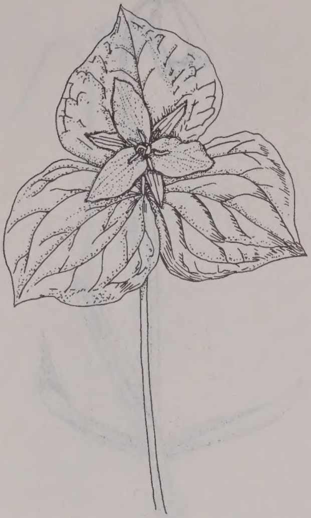
YELLOW BELLS (Fritillaria pudica) In early spring, the waxy blossoms can be found growing on moist hillsides and in open woods. They are rather rare except in favored spots. Picking them usually destroys the whole plant.



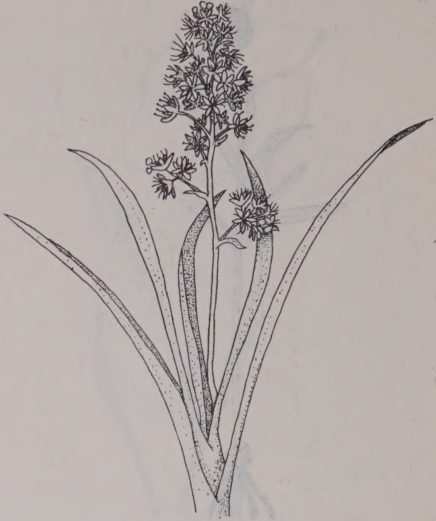
FALSE SOLOMON'S SEAL (Smilacina racemosa) Another leafy-stemmed member of the lily family. No forage value. Indians boiled the roots in lye to get rid of the bitter flavor, discarded the lye and reboiled the roots to make a staple food. The plant grows in abundance in moist open areas in the hills close to woods.



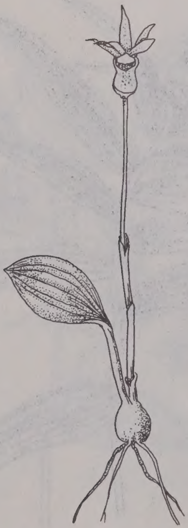
WILD LILY-OF-THE VALLEY (Smilacina stellata) Similar, in part, to False Solomon's Seal. It is smaller, however, and more out in the sun. It is of no value as forage.



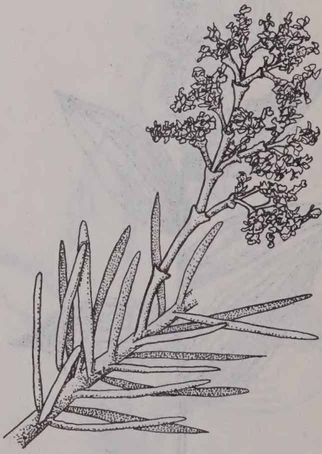
WAKE-ROBIN (Trillium ovatum) Another interesting member of the lily family. Flowers white and on a short stem. The trillium is of no significant value other than adding charm and beauty to the landscape.



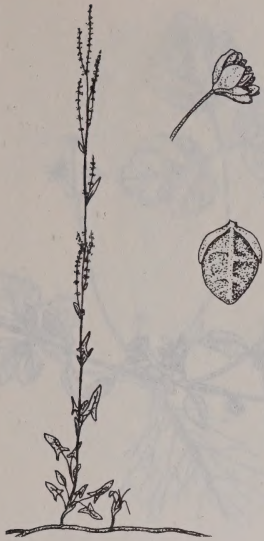
DEATH CAMAS (Zigadenus venenosus) One of the handsomest of this group. It is also deadly poisonous. Close inspection of the individual blossoms will show that they each resemble small lilies with yellow stamens. The blossoms are cream colored or sometimes pale yellow.



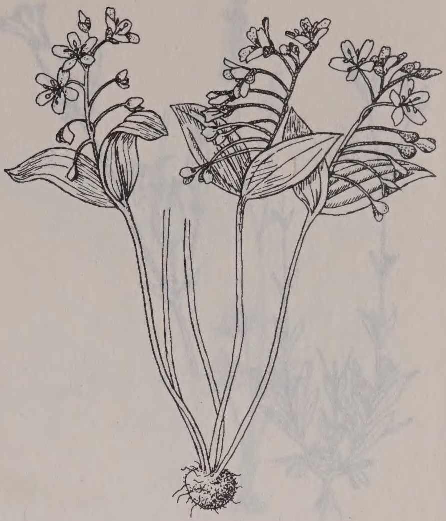
FAIRY SLIPPER (Calypso bulbosa) Six inches high and one of the more beautiful wild florwers in the forest. A member of the orchid family. Its flowers are variously colored. The plant has no food value or other economic importance.



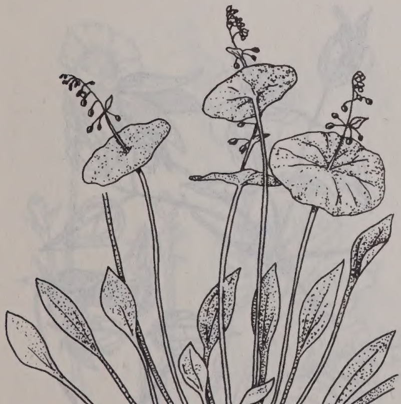
DWARF MISTLETOE (Arceuthobium campylopodum) Stems are orange-yellow to olive green or brownish. Found on a large number of the conifers that grow in north Idaho. While it may not actually kill its host it may weaken it to the extent that other factors will.



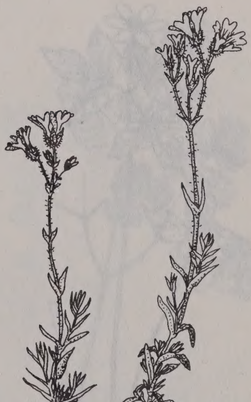
SHEEP SORREL (Rumex acetosella) This is weed species and is most likely to be found in disturbed areas of Mineral Ridge. Look for the redish flowers and fruits. It is somewhat poisonous to livestock but has long been used in the preparation of various foods, soups, etc.



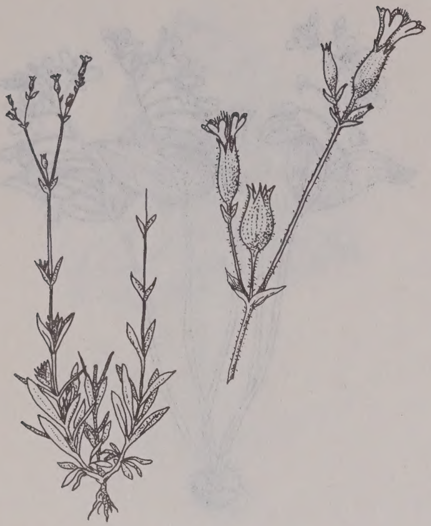
SPRING BEAUTY (Claytonia lanceolata) A bright green succulent little plant found mostly in shady moist places. Look for two little sepals underneath the petals. The greens are good in salads and the little bulb-like corms are edible.



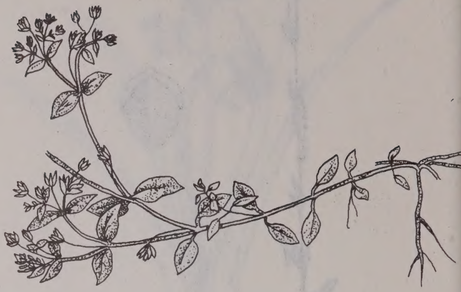
MINER'S LETTUCE (Claytonia perfoliata) Tender succulent plants with white flowers growing in moist open areas. Very palatable and readily used by outdoors people for salad. When gathering plants like this one for food, considerable care should always be taken as a poisonous plant may be growing alongside it.



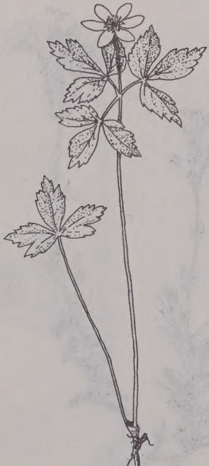
FIELD CHICKWEED (Cerastium arvense) A white-flowered field weed. Of no importance.



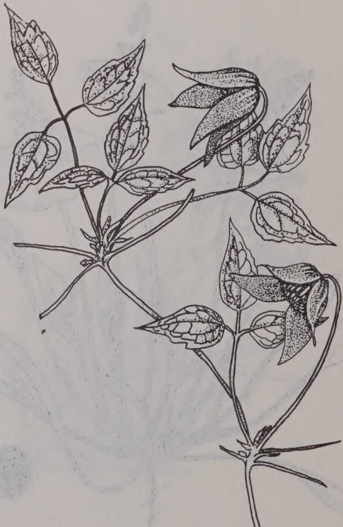
WHITE CAMPION (Lychnis alba) A perennial weedy species growing up to three feet tall. Not a native but an immigrant from Europe. It is not common in north Idaho. Of unknown value.



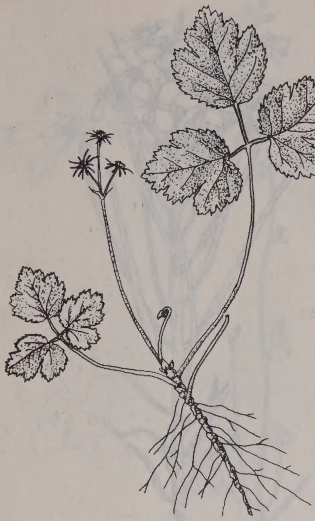
COMMON CHICKWEED, STARWORT (Stellaria media) An agressive weed often growing in mats in disturbed moist soils. Some relatives of this plant have small bulbs which are edible but our plant has no apparent value.



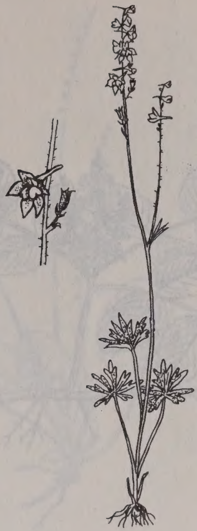
WIND FLOWER (Anemone piperi) This very delicate member of the buttercup family can be expected to be found in shady forest areas. Its single white flowers, which really don't have petals, are atop a cluster of three foliate leaves. It has no food value.



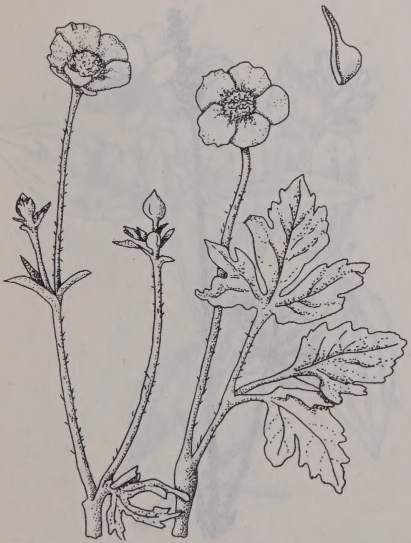
BLUE CLEMATIS (Clematis columbiana) This member of the buttercup family is a vine and has beautiful blue flowers. Of no known forage or food value.



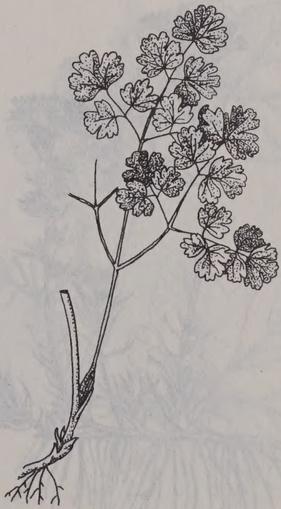
WESTERN GOLDTHREAD (Coptis occidentalis) A delicate, insignificant little plant, growing in moist, shady places in the woods. Of no value to animals or humans.



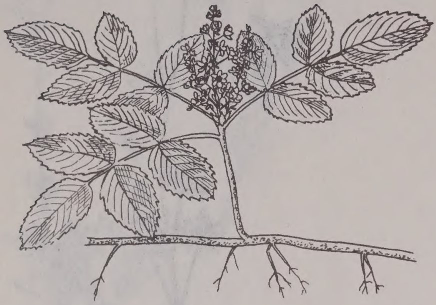
LARKSPUR (Delphinium depauperatum) Look for a small cluster of fleshy, tuberous roots. The flowers are blue and the plants may grow up to as high as three feet. This is a very important plant (the larkspurs as a group) economically for cattlemen because some of the species are highly poisonous. Sheep, however, are immune. It may be dangerous for humans.



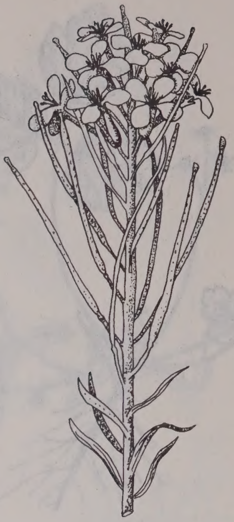
BUTTERCUPS (Ranunculus glaberrimus) Yellow or sometimes white. Their blossoms bear a resemblance to each other, but their habit of growth differs widely. Most of them like wet areas.



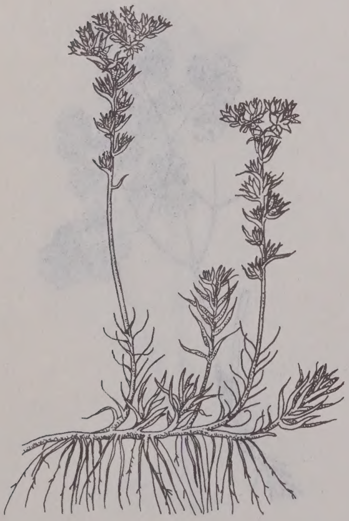
EARLY MEADOW RUE (Thalictrum occidentale) Shade loving, early season forest plant. Will seek moist areas along banks of streams. It has tiny white flowers and is a member of the buttercup family. It is of little or no value as a browse species. Extracts yield dyes and poisons.



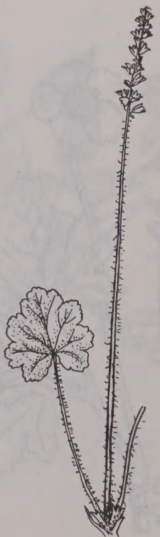
OREGON GRAPE (Berberis repens) The Oregon State Flower. Low growing half-shrub with shiny holly-like leaves. Older leaves will have red and yellow colorations. Likes open as well as shady hillsides. The berries are not poisonous but are apt to be very sour. Elk and deer will forage on it.



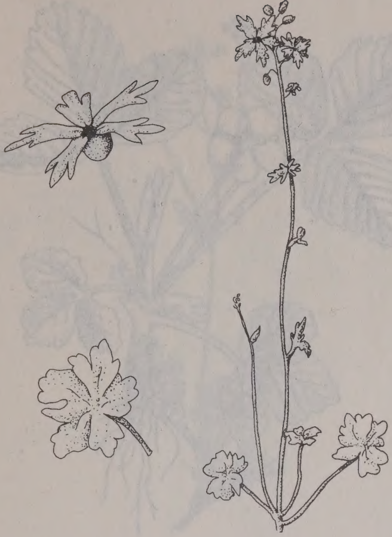
WESTERN WALL FLOWER (Erysimum asperum) A mustard with rich yellow flowers found mostly on bare exposed soils. Likes roadsides. Of no value for wildlife or livestock. Can be used as medicinal mustard.



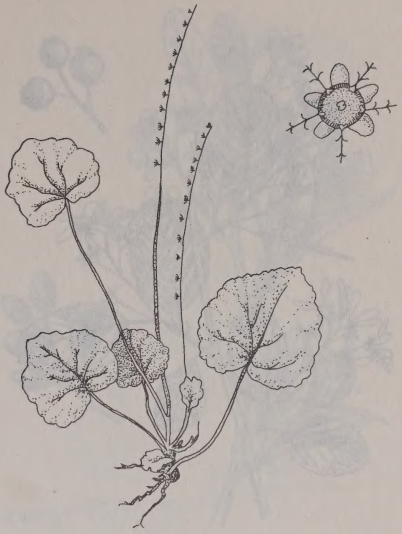
YELLOW STONECROP (Sedum stenopetalum) A succulent plant that runs along the ground in open rocky areas. Does not like shade. Plant parts are edible — particularly when young and tender — either in salads or soups.



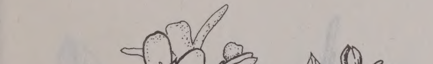
ALUM ROOT (Heuchera cylindrica) Also called "coral bells." This is a member of the saxifrage family and is never very abundant. Also since the herbage is sometimes fairly hairy, it is not taken by livestock. A concoction from the roots has been used as an astringent.



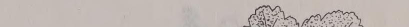
WOODLAND STAR (Lithophragma bulbifera) Snow-white blossoms show up in sharp contrast to the shady wooded places where it grows, reminding one of stars. They bloom in the spring. In one species bulblets develop in the axils of the leaves.



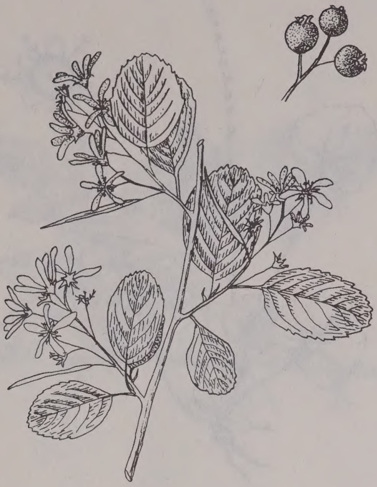
MITERWORT (Mitella stauropetala) A shade-loving plant. A lens is needed to really see the detail of the delicate blossoms. They are white and bloom in May.



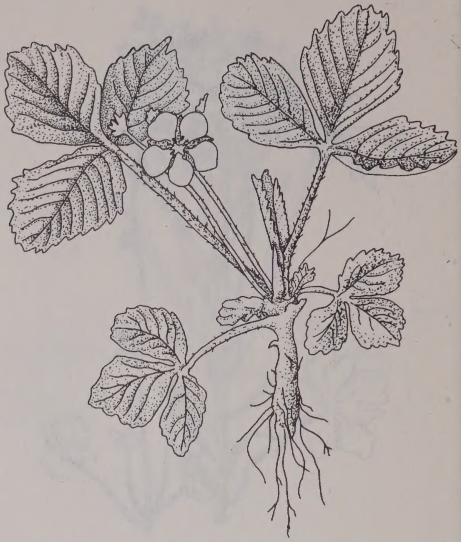
SYRINGA (Philadelphus lewisii). The State Flower of Idaho. Also called mock-orange. Its common name "Syringa" is the same as the latin name for the familiar lilac. Look for flowers with four petals, soft opposite leaves with veins which curve in toward the point. It is related to saxifrage, coral bells, currants, and gooseberries.



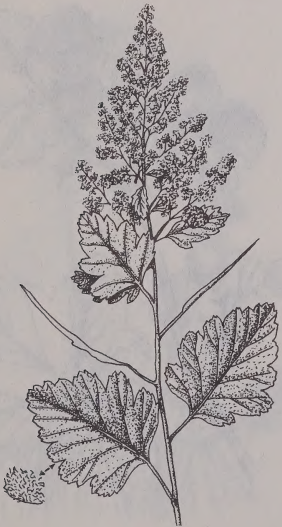
STICKY CURRANT (Ribes viscosissimum) Medium-sized shrub, two or three feet in height. Plant both fuzzy and sticky and is usually found in moist open slopes. Foliage and twigs of this plant are used to a limited degree. All species of currant and gooseberries produce edible berries.



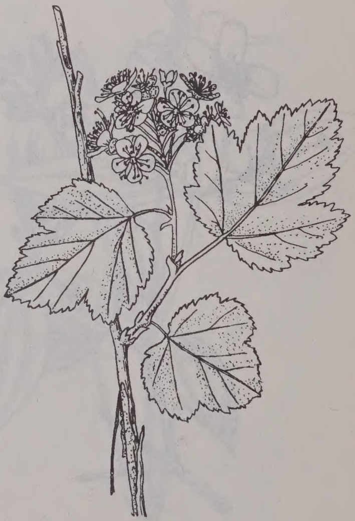
SERVICE BERRY (Amelanchier alnifolia) A very creditable member of the rose family. The spreading, large shrubs prefer the drier open hillsides. All service berries are edible and are one of the principal constituents of the Indian's "pemmican". The plants are also important browse plants for deer, elk, cattle and sheep.



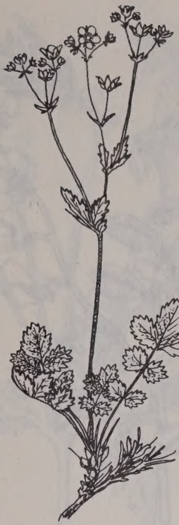
WILD STRAWBERRIES (Fragaria virginiana) Grow in wooded areas. In May they have white blossoms with white petals and yellow stamens. Their fruit is smaller than our garden varieties, but it is also sweeter. In our area, they are rather rare, and birds are usually the winners in the first-come, first-served contest for the harvest. In eastern United States, there are still areas where generous quantities of this choice fruit can be found.



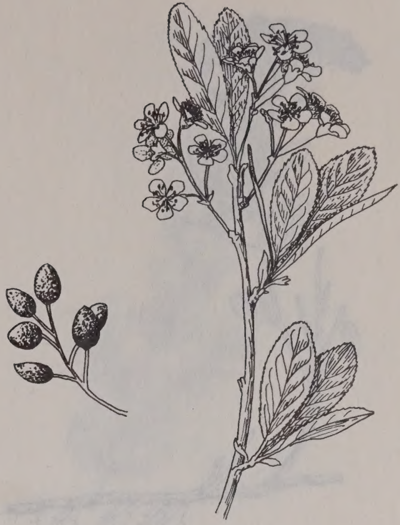
OCEAN SPRAY (Holodiscus discolor) A prominant member of moister, brush-covered hillsides. Look for tall, open shrub with slightly fuzzy leaves. Generally, it is of minor value as a browse plant, though it is taken by all range animals where it is abundant.



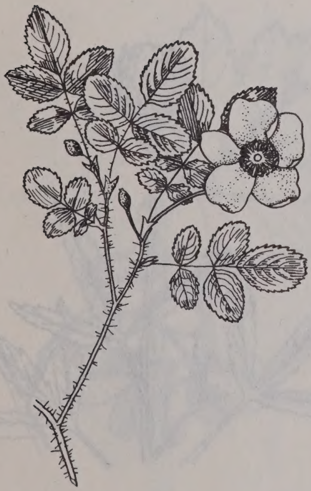
NINE-BARK (Physocarpus malvaceus) A medium sized shrub with soft dull leaves and clusters of white flowers. It is a member of the rose family. Its shreddy bark is a very distinguishing characteristic and it likes sunny medium elevation open hillsides. Good browse for elk in winter.



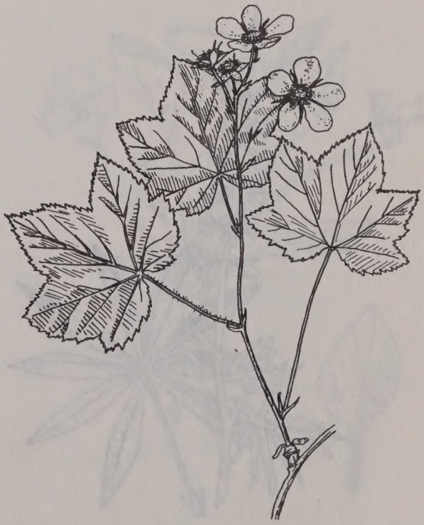
CINQUEFOIL (Potentilla glandulosa) Yellow flowered member of the rose family up to 1½ feet high. Utilized by deer but nothing else.



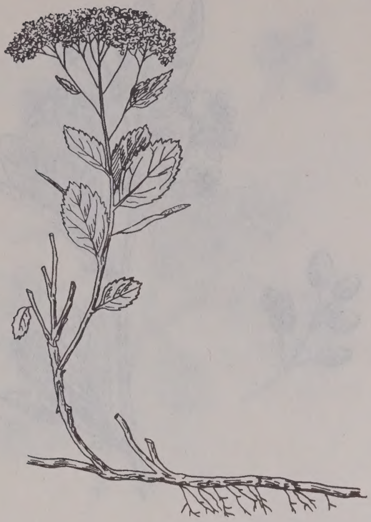
WILD CHERRY, FIRE CHERRY (Prunus emarginata) Tall, slender tree (comparing it with choke cherry) growing in open, moist areas in the mountain canyons. Flowers are white and the cherries are small and bright red. The leaves and twigs are eaten by deer and elk (also sheep) and the twigs, when bruised, give off a cherry odor. It is not poisonous.



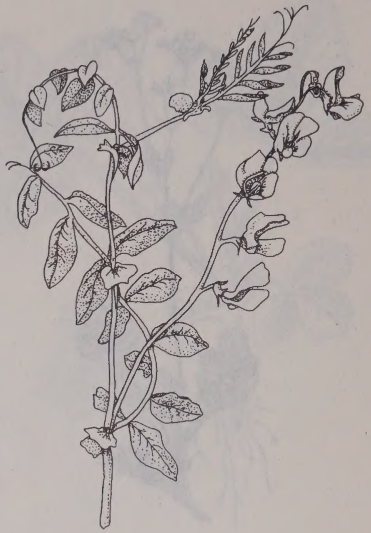
WILD ROSE (Rosa gymnocarpa) Grows on many country roadsides as well as in the mountains. Its blossoms are pink and very fragrant. In late summer and through the winter, their fruits (encased by a red fleshy covering called hips) are an important food for birds and small animals.



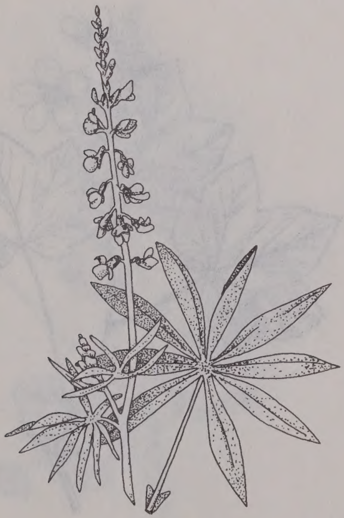
THIMBLE BERRY (Rubus parviflora) This member of the rose family is quite abundant in almost all moist and fairly shady mountain areas in north Idaho. The berries are edible and very refreshing on a hot summer afternoon.



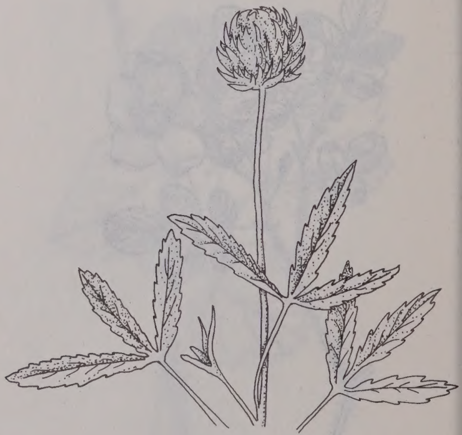
WHITE SPIRAEA (Spiraea betulifolia) Small, sparse shrub up to two feet high. The flowers are usually white but there may be some pink-flowered ones. Members of the rose family, the spiraeas have negligible value as browse for deer, elk, and livestock. Some of us owe the plant some degree of appreciation since aspirin is derived from its leaves.



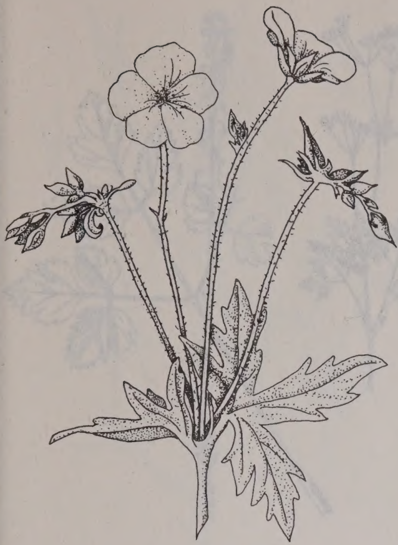
SWEET PEA (Lathyrus bijugatus) Represented by several species. They are the climbing members of the family and are beautiful in open woods and thickets. Their blossoms are pink (or sometimes white) but tend to turn greenish-blue as they fade. The shape of their flowers closely resembles those that grow in our gardens, but the garden species are larger and include a much wider range of colors.



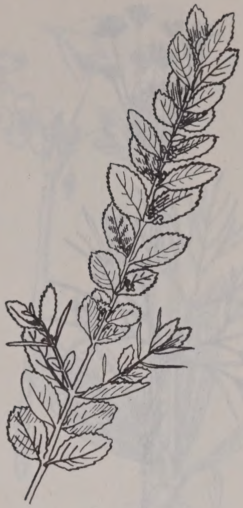
LUPINE (Lupinus wyethii) Grows at lower and middle elevations throughout our area. It is called BLUE-BONNET in Texas where it is the state flower. Most of the flowers are blue, but it is also sometimes pink or white. A taller species is a favorite garden flower.



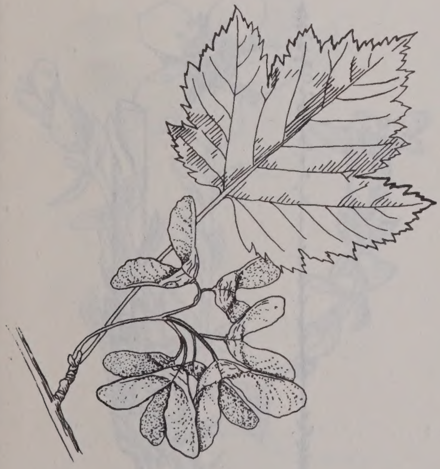
CLOVER (Trifolium hybridum) Familiar to us because it so often grows in our lawns. Its leaves are usually three parted but sometimes they have four leaflets and are thought by some people to bring luck to those who find them. The blossoms are white or pink.



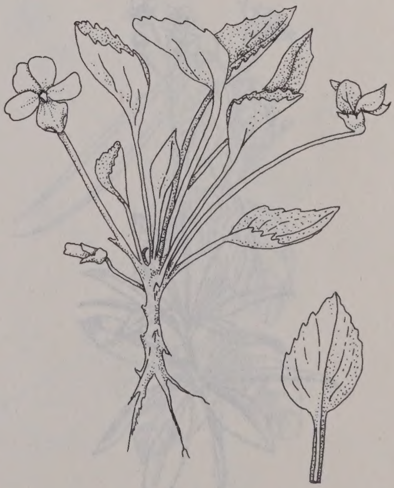
WILD GERANIUM (Geranium viscosissimum) An upright plant growing in our mountains and canyons. The blossoms are either pink or white. A smaller species grows in our valleys.



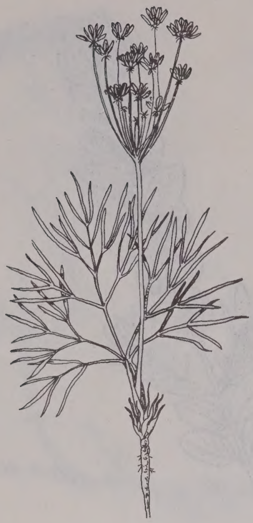
MOUNTAIN LOVER (Pachistima myrsinites) One of the smallest shrubs in the forest — seldom getting much more than a foot high. It has small (1 inch) shiny, dark-green leaves and tiny, four-petalled maroon flowers. It is valued as a landscaping plant.



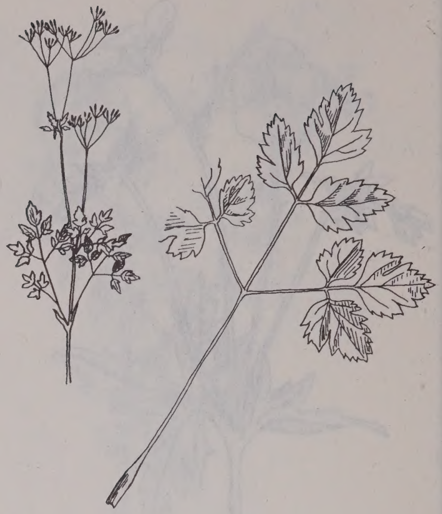
MOUNTAIN MAPLE (Acer glabrum) This tree is widespread in Idaho. Some species of maple (vine maple) are good for browse but the mountain maple is not one of them.



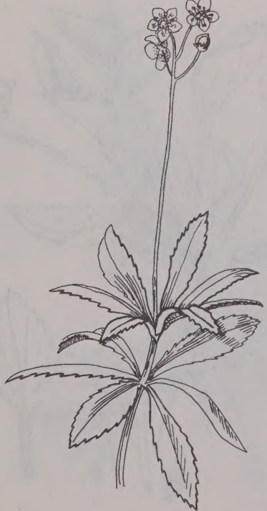
WILD VIOLET (Viola adunca) Look very much like those that grow in our gardens. Our native species all bloom in the spring and are not fragrant. None are more than a few inches tall. Our foothill violets are yellow or white and blue. Those that grow in the marshes and canyons are blue or white. Their leaves vary widely in shape.



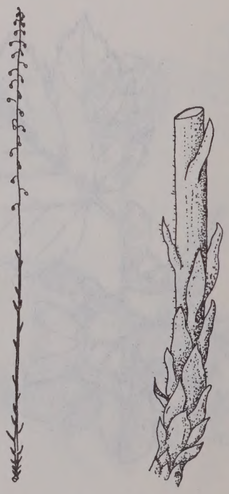
NARROW-LEAVED PARSLEY (Lomatium triternatum) May also be called Bisquit-root. Slender fragile plant, not much more than a foot tall and likes open grassy slopes. This plant is a member of the carrot family and its roots may be edible.



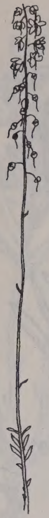
SWEET CICELY (Osmorhiza chilensis) White-flowered, sparsely growing member of the parsley family. It will grow up to three feet tall in north Idaho. It is palatable to deer, elk and livestock, but because it is not abundant, it is not considered important. Its roots are tasty to humans, raw or cooked. The plant and roots may have a slight licorice odor.



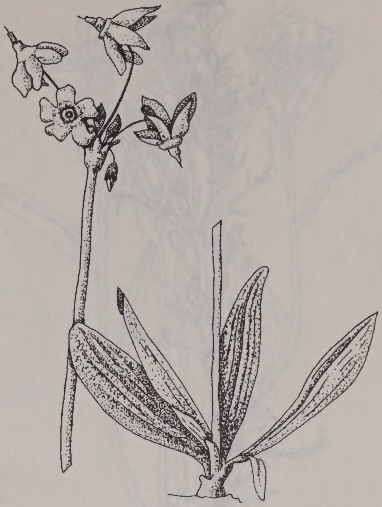
PRINCE'S PINE (Chimaphila umbellata) White to pink flowers. Found in moist forest areas along with its relatives, the wintergreens. Of little or no value as browse species.



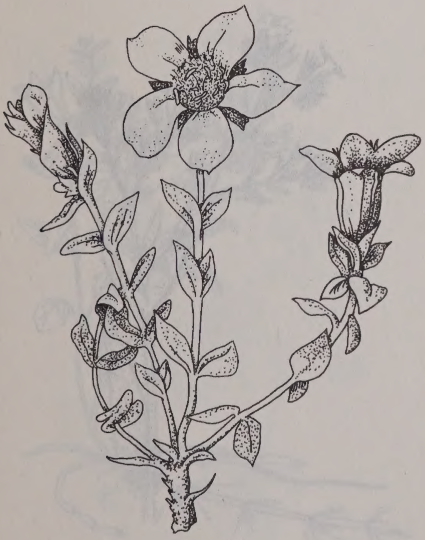
PINE DROPS (Pterospora andromedea) This is related to Indian Pipe and is parasitic on soil fungi. With white flowers, they should be found in rich moist soils in the woods. Of no forage or food value.



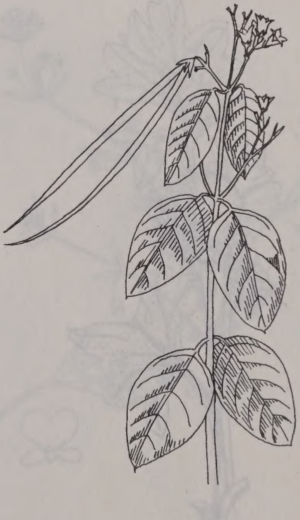
LEAFLESS WINTERGREEN (Pyrola aphylla) One of the several herbaceous members of the heath family that grow in the coniferous forests in north Idaho. It has no apparent value.



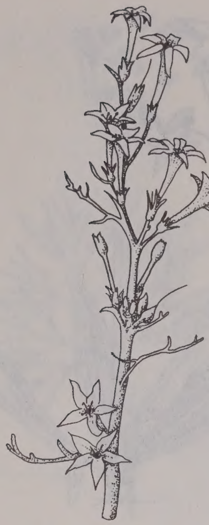
SHOOTING STAR (Dodecatheon puberulum) One of our favorite wild flowers. It blooms from May to August depending upon the elevation and often turns a whole meadow a soft rose-pink color for a week or so. It is delightfully fragrant.



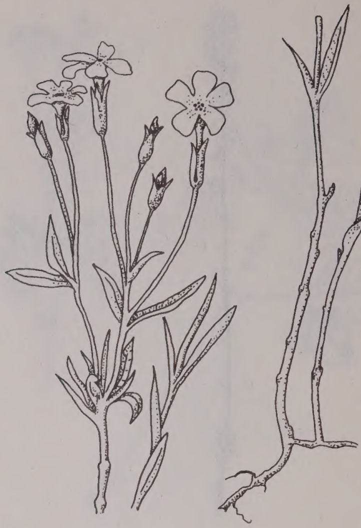
PLEATED GENTIAN (Gentiana amarella) The most beautiful member of this family in our area. It is a summer blooming meadow plant. Its flowers are blue, becoming greenish at the base. They are so sensitive to light that they will open and close as a cloud passes over the sun.



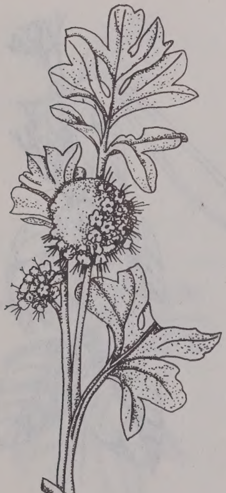
DOGBANE (Apocynum androsaemifolium var. pumilum) A low-growing, spreading herb that invades disturbed places and roadsides in mountain areas. It has no forage value for livestock or wildlife. It is, however, valued as a honey producer and some species have medicinal values. It has flesh-colored flowers.



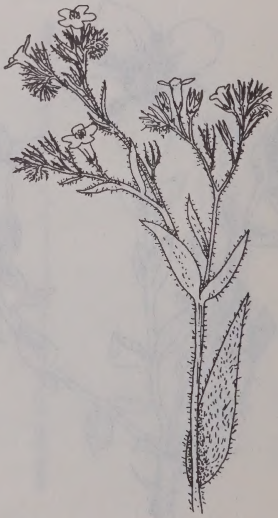
SCARLET GILIA (Gilia aggregata) Spectacular beauty because of its brilliant red color. They are common in our mountains. Not all of them are red. They range from snow-white through coral to scarlet. The plant is about two feet high.



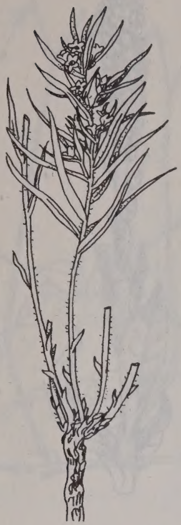
WILD PHLOX (Phlox longifolia) Forms pink or white cushions of bloom on our drying foothills in late spring. Phlox can often be found growing at its best in the protection of small shrubs like sagebrush. Its leaves are soft and gray-green. It grows 8 inches or 10 inches high.



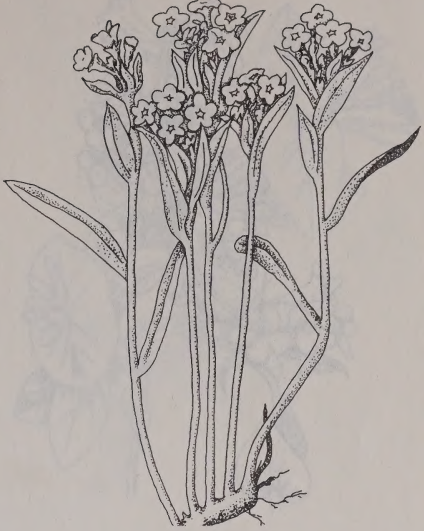
WATER LEAF (Hydrophyllum capitatum) A plant of wooded places that blooms in the spring, with blossoms that form a ball. It is pale lavender.



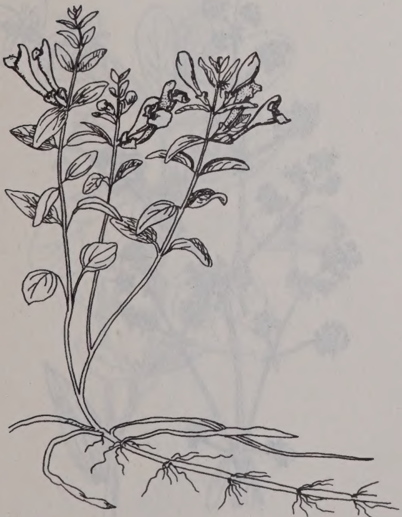
ALKANET (Anchusa azurea) A non-descript weed with dark blue to purple flowers. This plant is a member of the forget-me-not family and is of no value to livestock or wildlife.



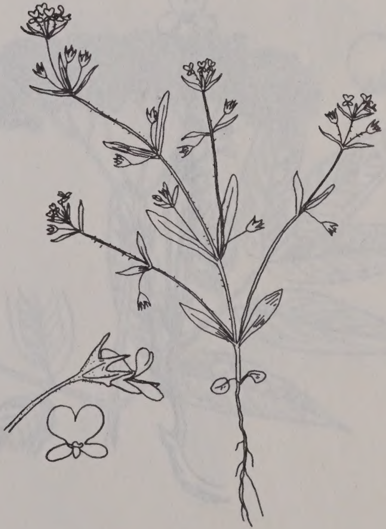
LEMON WEED (Lithospermum ruderale) A non-descript, weed-like plant. Flowers pale yellow and whole plant pale green. Latin name means "rock seed" as fruit consists of four hard, dark and tiny nutlets. Also called Gromwell. In the Forget-Me-Not family.



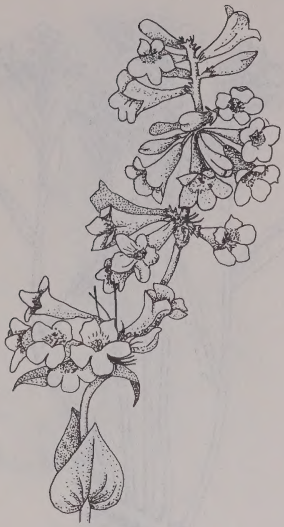
SHORTSTYLE BLUEBELL (Mertensia longiflora) Often mistaken for forget-me-nots. It is blue and very attractive. It is a foothill and mountain plant and blooms in the spring.



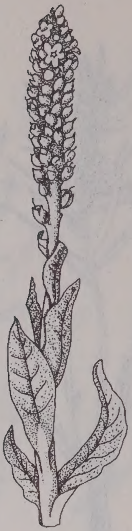
SKULLCAP (Scutellaria angustifolia) This little plant is a member of the mint family. It has deep blue flowers and is of no value as forage.



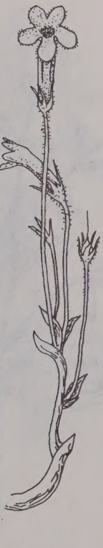
BLUE-EYED MARY (Collinsia parviflora) Belongs to the large and colorful snapdragon family. Look for the blue and white pansy like flowers. This is one of those delightful little plants that botanists sometimes call "belly-flowers" because one has to get down close to the ground to see what they really look like and appreciate their beauty.



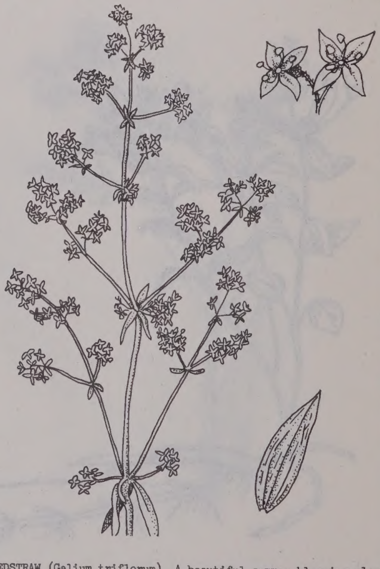
PENSTEMONS (Penstemon venustus) Are blue, lavender-blue, white, pink, and some red. They vary in height from a few inches to two or three feet. Some blossom in spring while others bloom in summer. The shape of the flower is the best key to identifying this group. Penstemons are primary invaders, which means that they grow on roadsides and in other areas where the earth has been disturbed.



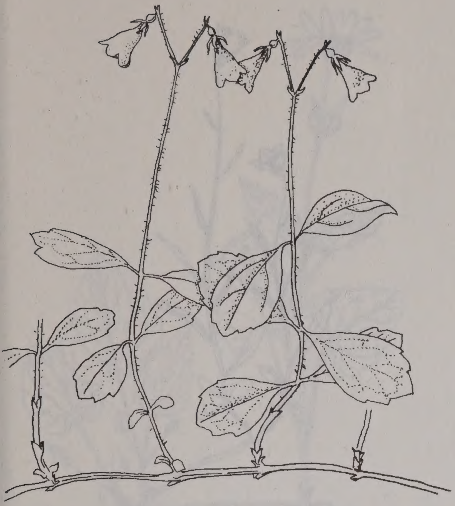
MULLEIN (Verbascum thapsus) A common plant on our roadsides. It was brought here from Europe by our pioneers who made candles by rolling its thick leaves and dipping them in tallow. They also used it in some medicines. Its yellow flowers bloom a few at a time at the top of its stalk. In favored areas it grows more than six feet tall.



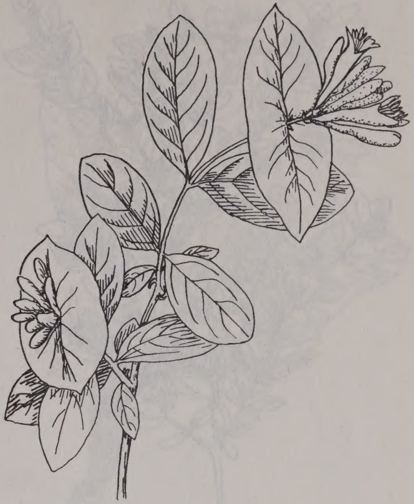
CANCER ROOT (Orobanche uniflora) Also called "broom-rape." This plant is a parasite as it derives its nourishment from the roots of other plants. It has red to purple flowers and no green leaves. It has no known food value.



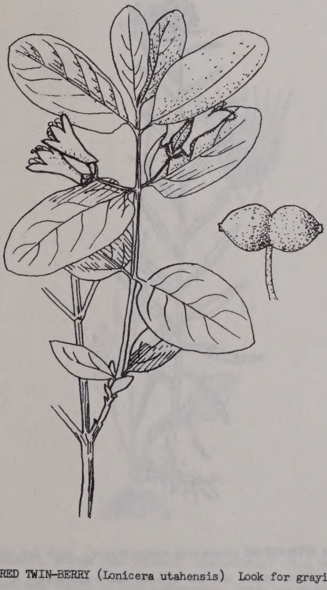
BEDSTRAW (Galium triflorum) A beautiful summer blooming plant with numerous white lacey blossoms. Each has four petals. The stems are square, with leaves arranged around them. Western Indians used this plant in making dye.



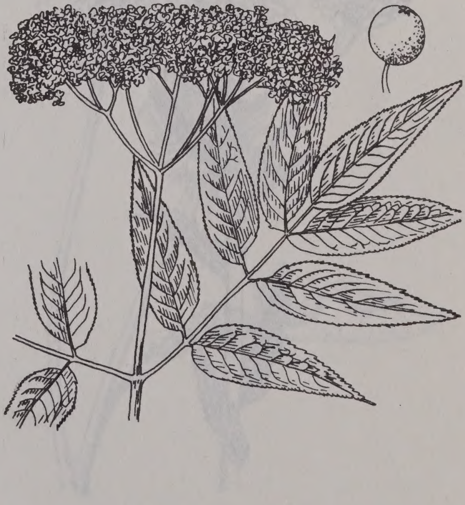
TWIN FLOWER (Linnaea borealis) This little plant is quite abundant in northern Idaho forests. It has little pink flowers that you might miss unless you get down on your hands and knees. The vinelike plant with lustrous shiny leaves runs along the ground and over logs, etc. It was named for Carolus Linnaeus, the Swedish physiciar and botanist who started our modern plant and animal classification system.



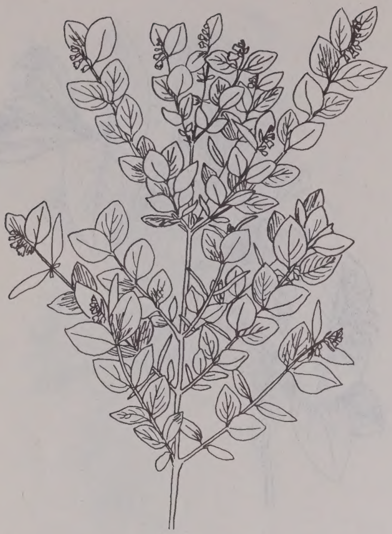
ORANGE HONEYSUCKLE (Lonicera ciliosa) Look for the bright green leaves of this vine-like plant. The two uppermost leaves have fused together to form an "involucre". It looks like the stem is growing through it.



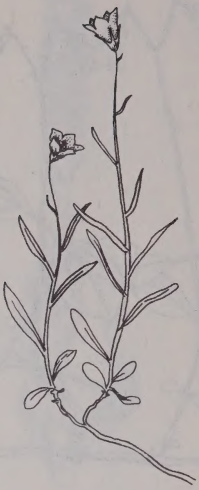
RED TWIN-BERRY (Lonicera utahensis) Look for grayish bark, yellowish flowers on the sometimes six foot high, widely branching shrub. This plant has little or no value as food for livestock and wildlife. The berries contain an emitic and should be avoided by humans.



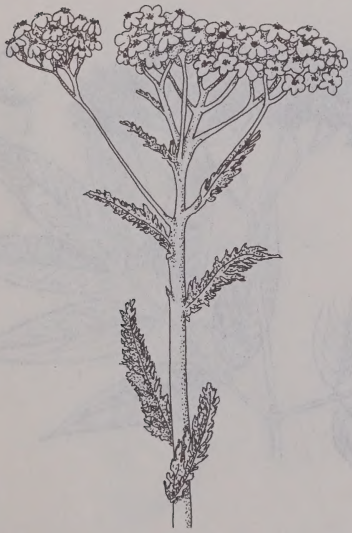
BLUE ELDERBERRY (Sambucus cerulea) One of the most widespread shrubs in the west. Look for the large compound and opposite leaves on tall, open shrubs. It is used in many interesting ways for foods, jellies, wines, etc. It is not of great value as a browse species.



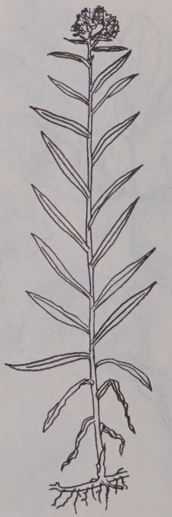
SNOWBERRY (Symphoricarpos albus) Very common, small mountain shrub which is highly valued as a forage species throughout the west. It is a member of the honeysuckle family. Look for opposite leaves and, of course, the spongy white berries.



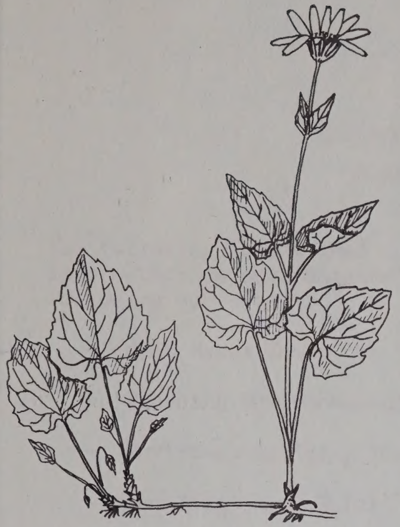
HAREBELL (Campanula parryi var. idahoensis) With blue flowers its grows only about a foot high and is not very abundant. It is, therefore, not of much importance as a forage plant.



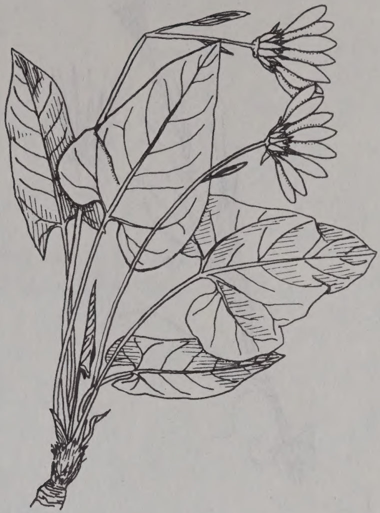
YARROW (Achillea millefolium) Blooms in the summer. It has whitish, or (rarely) pink blossoms and fern-like leaves. The whole plant is quite aromatic.



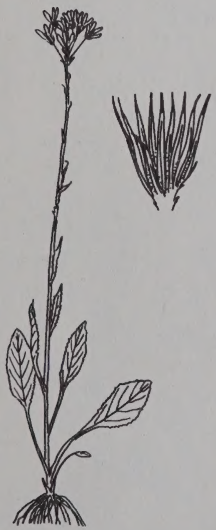
PEARLY EVERLASTING (Anaphalis margaritacea) Look for the dry, papery flower parts and the whitish dusty appearance of the plant. It is of some importance to land managers because it is such a vigorous invader after fires that it will crowd better plants out. It has no forage value. It is a member of the sunflower family.



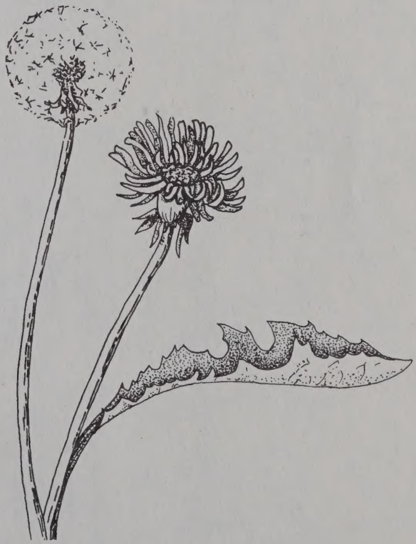
ARNICA (Arnica cordifolia) Has bright yellow, showy flowers and is found in moist, open-shade, tree-covered slopes. Its latin name means "with heart-shaped leaves" and it is a member of the sunflower family. A substance taken from the ground flowers has been mixed as a liniment for sore joints.



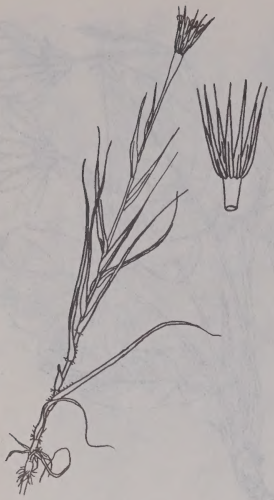
ARROW-LEAF BALSAMROOT (Balsamorhiza sagittata) Has also been called Mountain Sunflower. It is one of the most abundant plants in Idaho and dresses its hillsides in gold for a good part of the spring and early summer. It is grazed by sheep, deer and elk.



RAGWORT, BUTTER WEED (Senecio integerrimus) This member of the sunflower family is very widespread. These are valued by sheepmen as excellent forage for sheep as they are succulent and very palatable.



DANDELION (Taraxacum ovatum) Introduced into the United States from Europe and has become one of our most common weeds. If it were not so troublesome, its beauty would be more appreciated. Its clear yellow blossoms and white seed heads appear from early spring until after the autumn frost have killed most other plants.



GOATSBEARD, SALSIFY (Tragapogon dubius) A tall succulent weed that looks like a giant dandelion. It has been cultivated for its roots which, when cooked, suggest oysters. This one and a purple-flowered one are also called "oyster plant." Not of any value as a range plant.

ENVIRONMENTAL EDUCATION

GENERAL INFORMATION

The following is designed to provide the teacher with background information on environmental education generally, and contains the following subjects:

- What Makes Education Environmental?
- Teaching Environmentally
- Environmentalizing Your Classroom
- Knowledgeable, Guided Direct Interaction
- What About That World "Out There"
- How About That World "Out There"
- Beauty in Our Environment
- Conservation of the Outdoor Laboratory
- Sanitation in the Outdoor Laboratory

WHAT MAKES EDUCATION ENVIRONMENTAL?

WHAT ULTIMATELY MAKES EDUCATION ENVIRONMENTAL
IS NOT ITS SUBJECT MATTER, BUT ITS PROCEDURES

You can teach with your students, with your knowledge, and with your environments, no matter what your subject matter. On the other hand, you can take the subject of ecology and teach at your students about your knowledge about your environments. In the first example you are educating environmentally. In the second case you are perpetuating the gross error which underlies our current environmental predicaments: you are separating yourself from your environments (and your students from theirs) by forcing others to relate to you as if you were the environment rather than one environment among many.

What makes education environmental is the way it is experienced. If education is not experienced environmentally, then it is not environmental.

IT IS ONLY WHEN THE EDUCATIONAL EXPERIENCE
INCORPORATES THE DYNAMICS COMMON TO OTHER
ENVIRONMENTAL PROCESSES THAT IT CAN TRULY
BE CALLED ENVIRONMENTAL.

TEACHING ENVIRONMENTALLY

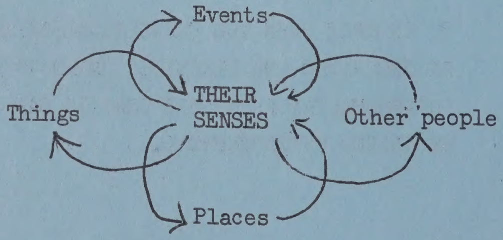
Students learn what we do better than they learn what we say. This is because they experience the way we do things more directly than they experience the information we convey. What our students really experience is our methods, not our data. They tend to assimilate our procedures, while only remembering our words. They become what we do.

For instance, when students are told in the classroom what democracy means, they may become very adept with the terminology of democratic theory. But only if they experience in the classroom what democracy means are they likely to be adept at democratic behavior.

> Ever wonder why people turn to authoritarian methods in their attempts to create a more democratic society?
>
> Who taught them to do that?

Students come to know best that which they experience most directly, that which they learn with. They tend to know less, because they experience less directly, that which they learn about.

The most important resources your students have to learn with are:



Do you teach with things, events, and places, or only about things, events, and places?

Do you teach with other people, or at them?

ENVIRONMENTALIZING YOUR CLASSROOM

Ever see a row in nature? With everything facing the same way?

Humans seem to be the only environment that organizes things in rows. Other environments tend to organize things in circles (or in cycles, which are circles in time).

What if you did what other environments do? What if you environmentalized your classroom? Not necessarily all of the time, but some of the time. At least once in a while.

How can you environmentalize your classroom?

Let your students look at one another.

> As long as all eyes are directed toward you, you tend to teach at your students, not with them. ABOLISH ROWS! Put chairs in circular rather than platoon formation.

Let your students talk to one another.

> Sit where they do—on the edge of the circle. Listen. Relate to their ideas and concerns, as well as your own. Ask questions which relate to their discussion. Make your contributions in a way that relates to their discussion. In other words, talk with them, not at them.
>
> (Q. But what if I can't relate to what they are saying?
>
> A. Then how are they going to relate to what you are saying?)

Let your students teach one another.

You are not the only one in the class who has pertinent ideas and information. In a mass-media, high-mobility culture such as ours, the collective knowledge and experience of your students is quite considerable. Tap into it, and utilize it for your objectives as well as theirs. Establish a cooperative atmosphere, where everybody gains by sharing his ideas and experience relative to the focus you have established.

Knowledge is the only form of wealth that increases when we give it away. A classroom in which all members are free to share relevant ideas and information is a gold mine. Attendance is high. Attentiveness is high. Morale is high. Learning is high. Schoolwork is not interfering with your students' education.

Let your students help you.

You have a lot to teach, and you have a lot to learn. You don't have much time for either when most of your time is spent running classes or preparing to run classes.

Set out the criteria for a well-managed class and have the students work out an effective system for self-management. Make the most of opportunities for them to learn cooperatively, teaching each other.

When you have done this, you will have freed your most important resource:

YOURSELF!

KNOWLEDGEABLE, GUIDED DIRECT INTERACTION

You environmentalize your class

1. when you find out what your students already know, relative to which you can make your broader knowledge meaningful to them;

2. when you provide for your students a direct encounter with the environment(s) being learned, involving them with the objective reality that your subject is about;

3. when, if #2 is not possible, you draw directly upon your students' past experiences with the environment(s) being learned;

4. when, if neither #2 nor #3 is possible, and they can only learn about the environment(s) in question, you provide within your classroom a direct encounter among all concerned with reference to the objective reality that your subject is about.

The elements which characterize the environmentalized classroom are knowledgeable, guided direct interaction.

knowledgeable of what your students already know that can be associated with what you want them to know

guided by your understanding of what information and resources they need

direct interaction among all who are involved in the learning task.

The general strategy for creating an environmentalized learning task is as simple as follows:

give your whole class a problem for joint solution, or a project for joint implementation, which requires of your students one or more of the following:

> current research with one or more of their environments;
>
> re-searching of their past experiences with one or more of their environments;
>
> original searching into their own and one another's thinking;

help your students to formulate what they already know relative to the task;

help them to define what they don't know, and guide them to the appropriate resources (people, organizations, printed materials, equipment, etc.) inside and outside the school;

help them to organize their efforts into a workable division of responsibility and pooling of results;

involve yourself in some aspect of the task which interests you, and learn something new while they do.

WHAT ABOUT THAT WORLD "OUT THERE"

We are inclined to think of environment as something "out there" which surrounds the individual and is different and apart from him, rather than a part of him. But an environment is not a static collection of objects "out there." Rather, it is an infinitely great number of factors with which the individual is in constant interaction. Everything that influences or is influenced by the individual is part of his ever-changing environments. Environment is total.

Each environment is different. It is specific. Each of our environments influences us whether we are aware of it or not, and does so differently than any other environment.

All environmental factors can be identified as Abiotic (non-living), Biotic (living), or Cultural (originating from humans), or as combinations of these. These are the "ABC's" of the total environment.

No environmental factors exist alone. Each factor is constantly interacting, changing the significance of the other factors to the systems of which all are a part. You don't fully understand one thing without considering everything else that relates to it.

HOW ABOUT THAT WORLD "OUT THERE"

"All systems are goal-directed. Self maintaining systems are organized to continue achieving their goal-directed results despite changing conditions. They manage this by readjusting the inputs of their parts to counterbalance changes which otherwise would throw their results off-target. However, if the individual factors within a system are required to change beyond certain limits in trying to maintain equilibrium, system-breakdown occurs.

"The outputs of systems eventually flow together as inputs into ever larger systems, eventually encompassing All. For example, insects are an important food for birds, whose droppings fertilize water algae in which fish feed and become an important food in the life support cycle not only of the birds—but of humans, some of whom may even obtain their economic support from fishing. Now, if we poison insects to protect, say, a plant crop, the consequence will very likely be the upsetting of this life support system of birds, fish, animals, and humans!

"To insure that man's actions do not upset his life-supporting natural and human ecosystems, he must make sure that his goals and actions are in tune with the natural goals of the environmental systems."

In other words

WHAT GOES FOR THE WORLD "OUT THERE"
ALSO GOES FOR THE WORLD "IN HERE."
THEY ARE THE SAME WORLD.

Beauty in Our Environment

Concept An interest in and appreciation of the natural environment should be reflected in desirable attitudes toward our country's beauty and bounty.

Purpose of Lesson To help students to become aware of and appreciate beauty as an important dimension in man's life.

Introducing the Concept Read the book *Happiness Is a Warm Puppy.* Define happiness with the class, directing the discussion to emphasize that enjoyment varies with the individual.

Ask: How can we preserve these special moments or places for others to appreciate?

Developing the Concept

Ask:

1 Why is it important to recognize beauty?
2 How may beauty be expressed?
3 Do you think it is important to share your feeling for beauty?
4 What experiences take place outdoors that cannot be enjoyed elsewhere?

Show the film *The Forest.* Use teacher's guide to lead discussion with students.

Plan a trip outdoors—a "soft shoe" walk. A "soft shoe" walk is a good method for experiencing the sounds of the forest. Signal the students at various times that "soft shoe" conditions are in effect. At this time there shall be no talking or other sounds. The walk can continue with appropriate stops signaled by the teacher or leader when distinct natural sounds are heard.

Extending the Concept Ask: How could you share with each other some ideas that express beauty?

Make a class book—*Ten Beautiful Things.* Suggest that each pupil be responsible for one page. Each page should contain ten ideas illustrated by pictures or sentence pictures. Compile all to form book.

Encourage students to make collections at home—wood, fallen branches, fallen leaves, seeds, nuts, feathers, etc. They may want to keep charts or records showing what, where, when, etc. Read to the students the book *A Friend Is Someone Who Likes You.*

Ask:

1 How do the values of a good friend affect your values?
2 How are respect for nature and self-respect related?
3 In what ways is an appreciation of the beauty in the outdoors important to our well-being? (More leisure time, increasing vacations, shorter working hours, higher income, tensions due to business and industry, home environment changes.)
4 In what ways is an appreciation of the beauty of nature important for our well-being in the future? (Provides recreation, healthful physical and mental use of leisure time for everyone; develops appreciation of spiritual, aesthetic, and cultural values; provides employment; attracts tourists; protects the outdoors against misuse, vandalism, carelessness, fire, erosion; creates interest in conservation.)

Conservation of the Outdoor Laboratory

Concept Group living requires cooperation within and between groups in order to maintain an optimum physical, social, and cultural environment for all.

Purpose of Lesson To help pupils recognize and understand the importance of keeping our natural environment free from trash or anything that would take away from its natural beauty.

Introducing the Concept On a blackboard or bulletin board, place this poem.

"Let no one say, and
Say it to your shame
That all was beauty
Here, until you came."

Ask: What does it mean?

Developing the Concept What things should campers practice and how should we carry out these practices? The teacher guides the discussion by asking questions such as:

1 What is the first rule of conservation? (Simple cleanliness.)
2 What should campers do to be sure this is carried out?
3 Why should campers not bury "non-burnable" refuse?
4 Where should the fire site be located?
5 How should you report a fire?
6 When should you build fires? When should you not build fires?
7 What other precautions should you use when building fires?
8 What should be done to protect the soil? Against what? Why?
9 What should be done to protect wildflowers?
10 What should be done to protect wildlife?
11 What are some things that can be done to improve the natural beauty of an area?

Extending the Concept If pupils are on a camping trip, an inspection should be held each day. Do not tell them the time of the inspection. Divide the camp into areas and give points on a basis of how each area looks. At the end of the camping period, give a housekeeping award to the area that has accumulated the most points.

The class now considers what action should be taken to help prevent the marring of nature's beauty by man's carelessness in throwing trash along highways, in state and national forests, parks, picnic areas, etc.

Fixing the Concept Ask: What activities in our camp are harmful to the environment?

Sanitation in the Outdoor Laboratory

Concept Disposal of all types of waste materials is necessary to maintain a healthful environment.

Purpose of Lesson To help students understand the need for sanitation in the outdoor laboratory or camp, and how to improve it.

1 Public to be taught proper methods of garbage and waste disposal.
2 Public to become sanitation minded and realize that camping facilities must be shared.
3 Owners of camp grounds should provide for disposal of all types of waste; garbage, toilets in camp ground, and dumping of self-units or trailers.
4 To point out problems such as overcrowding in public camp grounds.
5 Changes in the needs of campsites have occurred and must be met.

Introducing the Concept Show the film *Woodland Manners*. The picture points out that every visitor to the forest should observe the necessary sanitary measures, be careful with fire, and leave the forest as he would like to find it.

Developing the Concept

1 Practice properly cleaning up, disposing of all garbage and trash in your cookout in the previous lesson.
2 Consult references for proper methods of disposing of:
  a Paper
  b Grease
  c Tin cans
  d Raw garbage
  e Human wastes in camp
  f Human wastes in self-contained trailers

Extending the Concept

1 Make a study of sanitary provisions in public camp grounds.
2 Propose measures that could be taken to improve conditions of sanitation in these areas.
3 Clean up your own camp and suggest improvements.
4 Help younger students with cookout and teach them how to dispose of wastes properly.
5 Discuss sanitation in camp:
  a Washing hands
  b Keeping showers clean
  c Keeping living quarters clean
  d Proper disposal of human wastes in camp
  e Proper use of latrines for primitive camping
6 Consult State Board of Health for list of rules and regulations on sanitation in the camp. Make sure your camp *always* meets these requirements.

7 Make a study of newest trends in camping. Are changes in campsites being made to adjust to these changes?

Fixing the Concept

1 Discuss ways and means of improving sanitation in camp.
2 Put up a bulletin board on sanitation in camp.
3 Discuss ways and means by which sanitation in public camp grounds can be improved.

SOILS

The following is designed to supply the teacher with both general and specific information on soils:

- Formation of Rocks and Minerals
- Rocks
- Soil Formation
- Soil Depth
- Soil Texture
- Soil Erosion
- Soil Classification

Formation of Rocks and Minerals

Concept Rocks and minerals are slowly formed in the earth's crust.

Purpose of Lesson To help pupils understand the process of natural mineral and rock formation, and the need to conserve these valuable resources.

Introducing the Concept Display various minerals and rocks on the demonstration table. Try to have examples of sulfur, magnetite, galena, garnet, jasper, opal, rutile, quartz, tourmaline, feldspar, gypsum, olivine, obsidian, granite, basalt, tuff, limestone, schist. (These may be obtained from supply houses, or from the school's collection.)

Start class with this demonstration to arouse interest: A mixture of potassium iodide, manganese dioxide, and concentrated sulfuric acid (use care in handling the acid) is heated gently in a small beaker which is covered by an evaporating dish containing ice cubes. (Avoid inhaling the fumes.)

Developing the Concept Pupils will be attracted by the purple vapor. Start the lessons with these questions:

1 What are the vapors?
2 Why did they form a solid on the cool underside of the dish?
3 Where in nature would this phenomenon occur?
4 How long does it take?
5 What type of change in matter is this?
6 What type of mineral or rock would vaporize?
7 Where would the heat energy come from in nature?
8 When might we see this reaction?
9 How can we make minerals in the laboratory?

Let us try another demonstration to show how minerals are formed in the earth. Show the class alum crystals. Add about 1⅓ cups of alum to 1 cup of boiling water. Stir and allow to cool. Pour the solution into a glass beaker and put a piece of string over it. (The string may be suspended by tying it to a pencil and laying it across the top of the beaker.)

Ask these questions:

1 What will happen?
2 When will it show the crystals?
3 When does this happen in the earth?
4 Why does it take so long?
5 Why is there a difference in the size of the crystals?

Prepare solutions of diluted silver nitrate and sodium chloride. Drop a few drops of the silver chloride into the salt solution.

Ask:

1 What has happened?
2 When could this occur in nature?
3 Where would the chemicals come from?
4 How would they become hardened?

These are examples of how minerals might be formed in the earth.

Extending the Concept Show any of the films listed under *Instructional Materials.*

Ask the class to find ways to form sedimentary rocks. Suggest that some devise a way to grow other crystals. Be sure to note time involved.

Suggest that some pupils try to find a way to grow large and small crystals. (Where does this occur in nature?) Have each pupil take one of the specimens (obtain others) on the demonstration table and report to class the name, location, economic value, mining technique for obtaining from the earth, characteristics, crystalline (if from crystal), and availability. Suggest that some pupils make reports on man-made crystals, gems, minerals. (Why are crystals and gems not man-made in abundance?)

Fixing the Concept After some study and investigation, the pupils will be ready to supply an answer to these questions:

1 When will the supply of minerals and rocks fail to meet the demands of the people?
2 What can the city, state, and nation do about this problem?
3 How can science technology help to save the supply?

Rocks

Concept Bedrock is changed to rocks and soil by temperature changes and by the action of water, plants, and animals.

Purpose of Lesson To help children understand how heat, cold, and erosion have changed the surface of the earth and made soil.

Introducing the Concept Blow a large soap bubble. Compare the soil cover of the earth to the thin skin of the bubble: Although both coverings are thin, they are the most important parts. Even though the skin of the earth is very thin, it has taken millions of years to form. Many kinds of changes have been caused by different forces.

1 What would happen if boiling water was poured on a very cold glass?
2 What would happen if cold water was poured on a very hot glass? (Not Pyrex or Corning ware.)
3 Try these two investigations at home, if you haven't seen what happens.

Developing the Concept Investigate:

Do you think heat and cold could break rocks in the same way?

1 Heat a small piece of quartzite on a hot plate for 30 minutes. Drop it into some ice-cold water. What happens to the rock? Do you think large rocks outdoors might do the same thing? Why?
2 Fill a plastic jar full of water and cap it tightly. Place the jar in the freezing unit of a refrigerator. What happened to the jar? Why?
3 Soak a porous rock in water (notice the bubbles that rise from the rock). After 30 minutes take the rock out of the water and try to wipe it dry. What happens? Why?

Extending the Concept Field Trip: This trip should be to a place where rocks can be observed.

1 Have children feel rocks which have been exposed to the sun. Where did the heat come from?
2 What do you think might happen to the rocks when there are extreme changes in temperature?
3 Rub two rocks together for several minutes. What happens when the rocks have been rubbed together for a while?
4 Examine some soil with a magnifying glass.
    a What did you find in the soil? (Make a list.)
    b What do you notice about the rock particles found in the soil?
    c How do you explain this?
    d How long does it take for good soil to form?

Fixing the Concept Make a rock collection for exhibition in the classroom. Have children identify and label rocks they gather, when possible.

1 Why are small cracks left between squares of cement in a sidewalk?
2 Observe some rocks in a stream. Why are some rocks smooth?
3 Can you think of other forces which might change the rocks into soil?
4 What have you learned about the importance of this thin layer of soil?

3-4

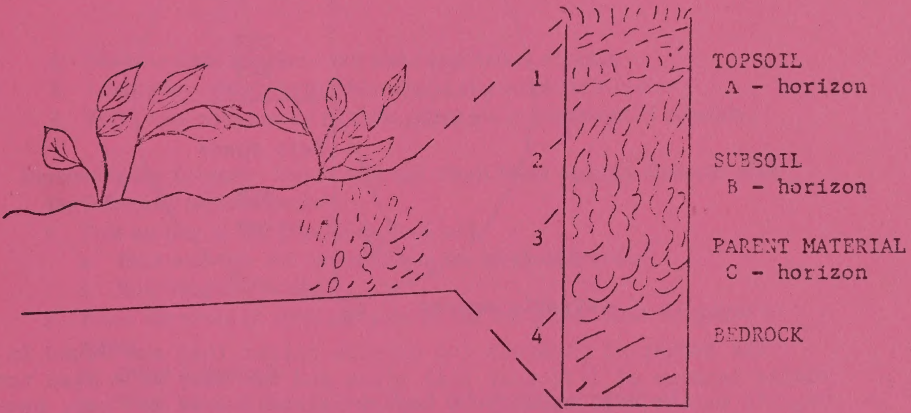
SOIL FORMATION

A soil is weathered rock fragments with decaying plant and animal remains that covers the earth in a thin layer. It furnishes mechanical support, food, water and air for growing plants.

The weathering of rocks to make soil is a slow process which has taken millions of years. Water freezing in cracks and crevices to break large rocks into small rocks was probably the first step. Rainfall, frost, and heat from the sun caused more breaking and crumbling of rocks into finer pieces. Dead plants and animals decay, giving off carbon dioxide which reacts with water to form a weak acid solution. This acid reacts chemically with some of the soil minerals to give finer pieces of rock or soil particles.

In the soil-forming process, definite layers of soil particles are distributed throughout the soil depth. We can examine these various components of the soil by examining a soil profile, which is a vertical exposure of soil layers. The profile is divided into four general parts:

1. Topsoil, or surface soil
2. Subsoil
3. Parent material
4. Bedrock



A Soil Profile

Topsoil

Most topsoils contain more sand and organic matter than the subsoils. Usually they are darker in color and can be distinguished quite easily from the subsoil under native conditions. On some farm land, due to plowing and other tillage practices, the line of demarcation between subsoil and topsoil is hard to determine.

Subsoil

Subsoil is between the topsoil and the parent material and/or bedrock. It generally contains a finer texture than the surface soil.

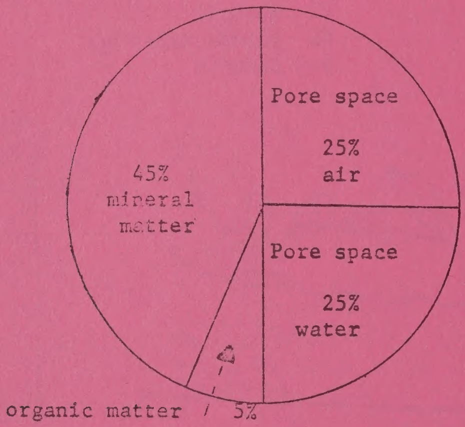
When large quantities of fine-textured particles are present, the soils are usually heavy, compact, having poor aeration and water movement. Sand subsoils have low water and nutrient-holding capacity, tend to become droughty, and are usually less fertile than the finer-textured soils.

SOIL COMPOSITION

A soil is composed of four ingredients:

1. Mineral matter
2. Organic matter
3. Water
4. Air

A desirable surface soil has the volume composition as shown below.



The amount of minerals and organic matter that are found in a soil varies because of different soil types and how they have been treated. Organic matter will usually be higher in soils used for hay, pasture, or forest, than one used for continuous cropping.

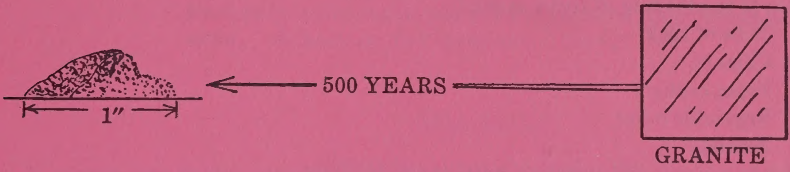
Soil Formation

Concept Chemical and physical changes in the earth's crust change rocks into soil.

Purpose of Lesson To help pupils understand the production of soil by the weathering of rocks.

Introducing the Concept Have these objects displayed on the demonstration desk:

1 Block of granite with a 1-inch pile of granite-derived soil nearby. Put placard marked 500 YEARS above the soil.



2 Shale or slate samples—hot plate and beaker of water.
3 Limestone—dilute hydrochloric acid or vinegar in a beaker.
4 Soft rocks with cracks in them. (Dry ice in container, if possible.)

Developing the Concept Pupils will ask about these objects. Proceed with the following demonstrations:

1 Pick up bits of the granite-derived soil.
  a How was this soil formed from the block of granite?
  b How long did it take?
2 Place the shale or slate samples on the hot plate. Heat. Immerse in water.
  a What happens?
  b What kind of change was this? (Chemical, or physical.)
  c What form of energy was used?
  d When does this happen in nature?
3 Drop the limestone in the dilute acid.
  a How does this happen in nature?
  b What form of energy was used?
  c When it happens in nature, where do the chemicals come from?
  d What formations does this reaction make in the earth's crust?
4 Fill rock cracks with water, prior to class. Put in dry-ice chest. Remove and check for cracks. (Rocks may be put into the freezing compartment of the refrigerator for this demonstration.)
  a How and when does this occur in the earth's crust?
  b What form of energy was used?
  c What types of changes of matter occurred?

Extending the Concept Discuss other processes of weathering: exfoliation and spheroidal oxidation, animals and plants, permafrost, and hydration.

Plan for field trip the next day to observe weathering of the earth's crust. Plan to illustrate different degrees of weathering. The specimens are to be classed as:

1 Smooth and unaffected
2 Smooth but colored
3 Gouged and stained
4 Deeply gouged
5 Crumbles in hand

These rock specimens are to be identified as to rock type also.

Following this trip work with the rock specimens.

Ask this question: What do the following factors have to do with the rate of weathering of rocks to soil?

1 Type of rock
2 Climate
3 Topography
4 Vegetable cover
5 Altitude

Try to answer this question with the rock specimens which you have found and other specimens in the room.

Investigate the rate of weathering by using the geomorphological models of folded mountain in the eastern United States and the block mountain of the western United States.

Note strata and discuss the soil formation in these areas.

Investigate the topographic maps of other areas. Note altitudes, creeks, elevation of banks, etc. Conclude this study with a chart to fill in the empty spaces, suggesting what might happen to the following types of rocks:

TYPE OF ROCK	TYPE OF WEATHERING Chemical-Mechanical (process)	CLIMATE	ALTITUDE	RATE
Feldspar				
Limestone				
Limestone				
Iron pyrite				
Cracks in granite				
Hematite to limonite				
Igneous Rock				
Shales				
Conglomerates				
Granite outcrops				
Lichen-covered rocks				

Fixing the Concept Would you agree with these statements after your study? *Soil is an irreplaceable natural resource, formed by many years of chemical and physical changes. It should be conserved.*

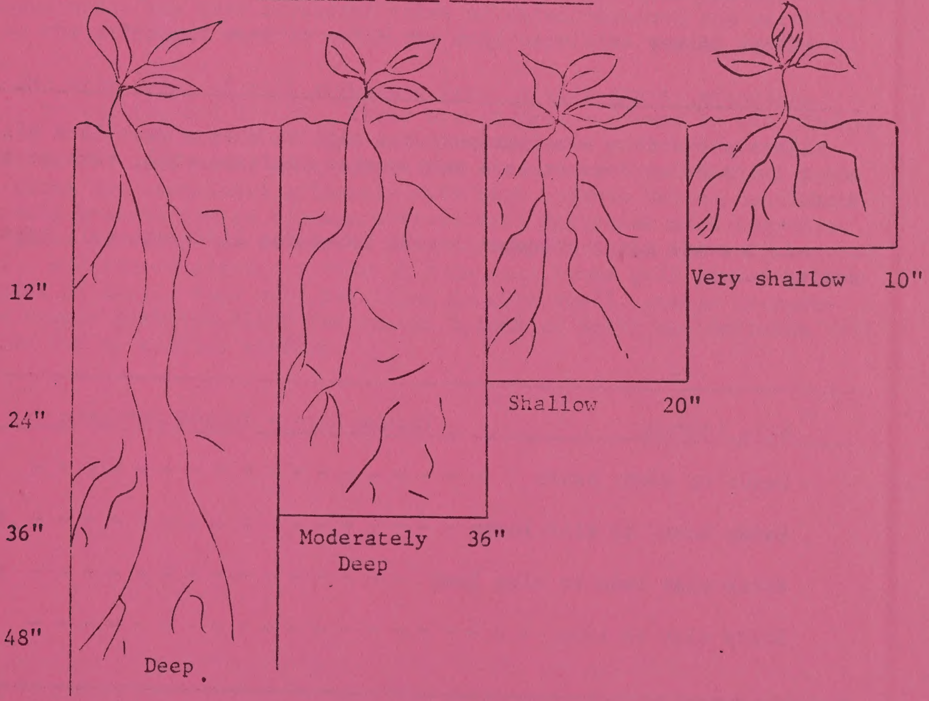
SOIL DEPTH

The depth of soil is determined by the total thickness of soil layers readily penetrated by plant roots.

1. Deep - These soils are more than 36 inches deep and root development is unrestricted.
2. Moderately deep - These soils are 20-36 inches deep and only moderate root restriction.
3. Shallow - These soils are 10-20 inches deep, restricts root growth, nutrient and water feeding zones. Much of Idaho's agricultural soils falls in this category.
4. Very shallow - These soils are less than 10 inches deep. Severely restricts root development and feeding area. Suitable for pasture crops.

Soil Depth

Effective Root Penetration



A deep soil has more area for roots to grow and explore for water and plant food. Different plants have different root patterns, these root patterns will determine how the soil is managed and which crops are best adapted.

SOIL TEXTURE

Soils are composed of particles of various sizes depending upon the material from which they were formed. Sand, silt and clay particles and the proportion of each determine soil texture.

The soil texture will determine to a great extent the amount of water and plant food a soil will hold. Sandy soils will hold less water and plant food than silt or clayey soils. This is due to the amount of surface area in a specific volume of each texture. The finer the texture, the greater the surface area.

Soil Texture	Available Water - Inches per Foot of Soil Depth
Sandy (very coarse)	½ - 1
Sand loams (coarse)	1 - 1½
Silt and clay loams (medium)	1½ - 2
Clays (fine)	2 - 2½

This shows that a medium textured soil such as a silt loam will hole about twice as much water as a very coarse textured soil, such as a fine sand.

An average range of water intake rates for different soil textures are listed below:

Soil Texture	Intake Rate - Inches per hour
Sands to loamy sands	5+
Sandy loams to silt loams	0.2 to 5
Silty clay loam to clay loam	0.05 to 0.20
Silty clay to clay	0 to 0.05

As indicated in the table, it could take an inch of water 100 times longer to enter into a clay soil as into a fine sandy soil.

MOVEMENT OF AIR AND WATER (Permeability)

Soils may be placed into permeability classes through studies of structure, texture, cracking, density, and other features.

1. Very Slow
   These soils have dense, heavy clay or clay pen soils.
2. Slow
   These soils have crumbly, clay loam subsoils.
3. Moderate
   These soils have highly granular, loam subsoils.
4. Rapid
   These soils have sandy subsoils.

SOIL STRUCTURE

Water movement and aeration are also influenced by soil structure. Soil structure is the arrangement and grouping of soil particles. Similar textured soils may have different rates of water movement and aeration, due to the different ways in which the soil particles may be arranged.

The main types of soil structure are: single grain, granular, platy, prismatic, and blocky. These structures are formed in the process of soil formation and in tillage and movement. We prefer a granular structure for good water penetration and air movement. Granular structures are associated primarily with high organic matter content. When soil becomes low in organic matter, soil particles pack together. This gives slower water movement, fewer air spaces, and the soil becomes heavy. Additionof organic matter to form soil humus will glue together hundreds of small, fine soil particles to give small, stable granules. These stable granules allow for faster intake of water and decrease soil erosion due to surface erosion.

SOIL EROSION

Soil erosion is the dislocation of soil particles due to the effects of wind or water. The rate of water erosion depends upon the following factors:

1. The amount and intensity of rainfall distribution.
2. The slope of the land
3. The type of vegetative covering.
4. Soil texture and structure.
5. The size and shape of the land surface.

These factors acting together determine how much water enters the soil, how much runs off, and the resulting amount of soil which accompanies the water runoff.

The major agricultural erosion control methods used employ a land use compatible with its land slope and soil characteristics, i.e., contour tillage, strip cropping, row crops grown only on gently sloping fields, use of sod forming crops in natural water ways and run off areas, or leaving land in native vegetation if erosion potential is excessive.

All soils are affected by wind erosion. The major factors affecting the damage caused by wind erosion are:

1. Wind velocity.
2. Soil surface conditions.
3. Soil characteristics.

Wind erosion is less severe when soil surfaces are left rough and this can be accomplished through proper tillage methods and using stubble mulch techniques to reduce exposure of soil particles to wind velocity. Soil particles of single grain nature such as fine sand and silts are extremely erosive when subjected to high winds. Thus the sand dune and drifting conditions observed in the Fort Hall area.

Erosion of Soil by Water

Concept Soil erosion by water is an example of the constant change in the planet's crust.

Purpose of Lesson To help pupils investigate the causes and prevention of soil erosion.

Introducing the Concept Prepare to visit the school campus. Plan with pupils these ideas for their observation:

1 Note examples of erosion.
2 Note where the materials are deposited.
3 Note size and kind of deposit.
4 Sketch the eroded earth and make an estimation of the time it took to cause the erosion.
5 Note gradient of eroded hill, size of gully.
6 Make conclusions.

Assignment: Note examples of erosion as you return home this afternoon. Draw conclusions.

Developing the Concept After trip outside ask questions:

1 What energy is being used to move the materials in schoolyard?
2 What types of change is the matter undergoing?
3 Where does the matter go?
4 What is being lost?
5 Why should the soil be kept?
6 Where does this happen most often?
7 What does the velocity of water have to do with the carrying load of a stream?
8 What happens when the velocity of water becomes less? What is formed?
9 What does the size of the objects in the stream load have to do with the grinding power?

Extending the Concept Investigate erosion in our community. What has been done to prevent this condition? Why should "city dwellers" be concerned with the scientific methods of erosion prevention? Use films to demonstrate how erosion might be stopped. The class should stress the reason for these methods and why each is necessary. These methods should include:

Strip-cropping
Cover cropping
Contour plowing
Crop rotation
Forest and woodland planting
Gully control
Mulching
Terracing
Permanent pastures

Have someone investigate velocity and stream carrying power.
Devise a formula to determine this. (Flume studies.)
Have students make a contour map of schoolgrounds.
From maps draw conclusions as to the problems of erosion on campus.
Invite county surveyor to assist in this study.

Erosion of Soil by Wind and Gravity

Concept Soil erosion by wind and gravity is an example of the constant change in the earth's crust.

Purpose of Lesson To stress the importance of keeping the soil, and suggest ways of preventing soil erosion by wind and gravity.

Introducing the Concept A model sand dune might be simulated. Get pile of sand (coarse, fine, small gravels), fan or electric sweeper, soil box. Allow the fan or sweeper to blow on the sand in the soil box.

Developing the Concept Open the discussion with these questions:

1 What form of energy blows the sand?
2 Why is the wind able to move sand?
3 Where does this occur most easily?
4 What is the wind removing from the earth's crust?
5 How does gravity move soil?
6 Where do we see evidence of this?
7 Where is mass wastage greatest?
8 How does this affect soil erosion?
9 Where have you heard of great landslides, mudslides?
10 What damage did they do?

Extending the Concept Fill the sand box and elevate. What now pulls the sand down?

Moisten the soil and sand in the box. What have we now produced? What has this massive slide carried? Why is it important?

Suggest ways to prevent the erosion by the wind. Have you seen examples of how erosion has been prevented at the beach? On the dunes and on the strand? Have you seen the wind carry valuable topsoil away from a plowed field?

Devise ways of preventing wind erosion in the soil box. Have groups try this.

Devise ways of preventing mass wastage. How does the conservationist protect the soil on a steep gradient?

Show film *The Dust Is Dying.*

Soil Erosion—Causes and Prevention

Concept Some changes in environment are caused by man's carelessness and thoughtlessness.

Purpose of Lesson To help students understand that land can be damaged by erosion caused by removal of soil cover, floods, bad farming practices, and lack of plants.

Introducing the Concept Field Trip: Before the time for the field trip, the teacher should spot a number of places that would show definite results of erosion caused by water.

A ditch or gully on the school ground or campsite caused by erosion would be the logical place to start. This field trip would be most effective if made after a heavy rain. Children would learn many things by being out after a rain. As the tour progresses, allow children to run up and down eroded bank, feel the soil, observe the absence of plant life, note the color of soil, examine the soil for signs of animal life. As the observation is being made, the soil may be carried away by the water. Catch some of the muddy water to be investigated later.

Take sample of soil.

Ask questions which provoke thought and observation. What caused the erosion in each case? (Example: Cutting of a road, cutting of trees and plants, improper farming practices, etc.)

Where does the eroded soil go?

Developing the Concept On return from trip:

1 Children observe the sample of soil collected.
2 Observe silt which settles in jar of water.
3 Note absence of any animal life in the poor soil sample.

Allow the children to shake jar of water with soil in it. Here is a jar of muddy water; you know where it comes from. What is muddy water? Muddy water is so common to most of us that we do not stop to realize that it carries away our soil, which is real wealth. Why do you think streams and rivers are muddy after a rain?

Show the filmstrip *The Muddy Raindrop.*

Follow filmstrip with guide for questioning and emphasizing points of value.

Do you think beans, potatoes, tomatoes, or watermelons would grow in the ditches or eroded places we saw? Why not?

Extending the Concept

1 Have pupils measure the ditches or gullies near the area. Check the length, width, and depth, and record them.
2 Drive wooden pegs on sides and at the head of the gully measured to assist in remeasuring it later.
3 After several hard rains, remeasure the gully.
4 What do you notice about the people who live here, their homes, their dress?

Invite a consultant from Soil Conservation Service (local or state) to plan with the class a field trip where the children might see good soil conservation practices.

Fixing the Concept Save the soil and muddy water collected on the field trip. Provide the class with large sheets of construction paper and crayons or paint and suggest: there might be many ways of stopping the erosion or washing away the soil as we have seen it happening. First, THINK and then SHOW on your paper what you think might be effective in stopping the erosion. Pupils may wish to make a model farm showing good practices they saw at the farm.

THE LAND CAPABILITY CLASSIFICATION

A. Land Suited for Cultivation and Other Uses

Class I - Soils that have few hazards or limitations that restrict their use. Soils in this class are suited to a wide range of plants and may be used safely for cultivated crops, pasture, range, woodland, and wildlife. These soils are nearly level, and the erosion hazard is low. They are deep, well drained, and easily worked. They hold water well and are either well supplied with plant nutrients or highly responsive to applications of fertilizer.

Class II - Soils having some limitations that reduce the choice of crops or require moderate conservation treatment. Soils in Class II may be used for cultivated crops, pasture, range, woodland or wildlife, but require more careful management. Limitations are few and practices are easy to apply. Some of the limitations include effects of (1) gentle slopes, (2) moderate erosion hazards, (3) less than ideal depth, (4) slighly unfavorable soil structure and workability, (5) wetness that can be corrected by drainage, and other minor limitations.

Class III - Soils having severe limitations that reduce choice of crops, or require special conservation treatment or both. Soils in Class III may be used for cultivated crops, pasture, woodland, range or wildlife, but when used for cultivated crops require conservation practices that are more difficult to apply and maintain. Limitations may result from effects of (1) moderately steep slopes, (2) severe erosion hazard, (3) shallowness, (4) low water-holding capacity, (5) moderate effect of salts or alkali, (6) low fertility, not easily corrected, (7) moderate climatic limitations, and severe limitations.

Class IV - Soils having very severe limitations that restrict choice of crops, require very careful management or both. Soils in Class IV may be suited for only two or three common crops, pasture, woodland, range, or wildlife. Limitations include the effects of (1) steep slopes, (2) severe erosion hazard, (3) shallow soils, (4) low water-holding capacity, (5) poor drainage, (6) severe salinity or alkali and other severe limitations.

B. Land Generally Not Suited for Cultivation

Class V - Soils having slight erosion hazard, but have other limitations that restrict use to pasture, rangeland, woodland, or wildlife. Soils in Class V include (1) bottomlands subject to frequent overflow or high water table, (2) nearly level soils that short growing season prevents production of cultivated crops, (3) level or nearly level stony or rocky soils.

Class VI - Soils having severe limitations that make them generally unsuited for cultivation and limit their use to rangeland, woodland, or wildlife. Soils in Class VI have limitations such as (1) steep slope, (2) severe erosion hazard, (3) stoniness or rockiness, (4) shallowness, (5) severe climate and other severe limitations.

Class VII - Soils having very severe limitations that make them unsuited for cultivation and restrict their use to grazing, woodland or wildlife. Soil restrictions are more severe than those in Class VI because of very steep slopes, erosion, shallow soil, stones, alkali, unfavorable climate, and other limitations.

Class VIII - Soils and land forms having limitations that restrict their use for commercial plant production and restrict their use to recreation, wildlife, water supply or scenic purposes. Soils and land forms in Class VIII include bare lava flows, steep nearly-bare mountains, river wash and other nearly barren lands.

Properties and Classification of Soil

Concept The properties of the soil determine its use.

Purpose of Lesson To help pupils observe and investigate soil properties.

Introducing the Concept On the day of the lesson, the pupils are taken to two sites selected by the teacher. One of these sites should be level or nearly level and have all three layers (topsoil, subsoil, parent material). The other site selected should be sloping land where all of the topsoil has been removed by erosion. A hole is dug through the topsoil, subsoil, and into the parent material. Pupils can compare the profile at the two sites. What is the explanation for what they see?
What is the difference in profile at sites A and B and what is the reason for these differences? The teacher acts as guide by asking questions such as:

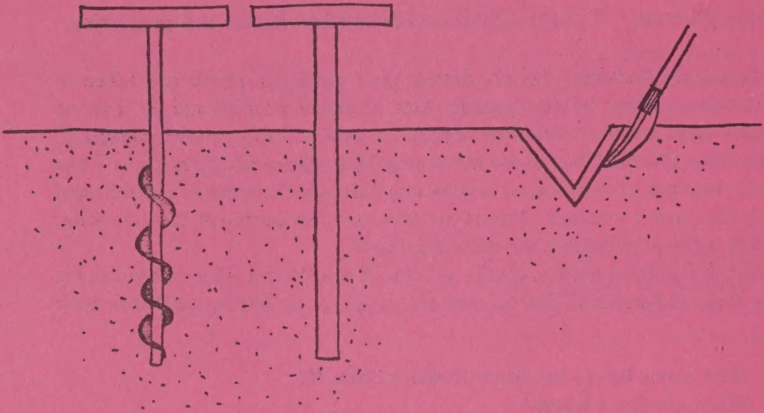
1 How many layers are there at site A? Site B?
2 What are these layers?
3 How can you tell where one layer stops and the other starts?
4 Why are the layers at site A not the same as at site B?
5 What is this difference?
6 Why does the difference exist?
7 What effect does this have on the use of this soil?
8 What can be done to correct this?
9 What can be done in other areas to prevent this from happening?

Developing the Concept How can we determine the nutrient or fertility level of the soil? Students suggest that a soil sample be taken and analyzed. Students are provided with resource material and asked to find out how to take a soil sample. The most generally accepted procedure is as follows:

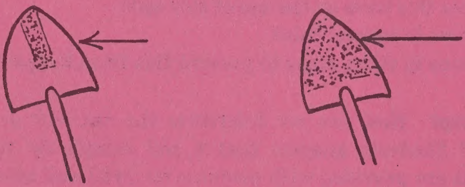
1 The area should be divided up into areas or fields not larger than 5 to 10 acres. Areas that are different in appearance, slope, drainage, soil type, or past treatment should be sampled separately, even though smaller than this.
2 Take separate composite samples of each area or field. Each sample is made up of 15–20 borings, taken as in Sample No. 1 in diagram for each soil area or field. A soil tube, soil auger, or narrow-bladed trowel are preferable, but a satisfactory sample can be taken with a spade and knife.
3 Avoid taking sample from fertilizer band when sampling field planted in row crops.
4 The soil is easier to sample when its moisture condition is suitable for plowing.
5 Any clods or lumps should be broken up before they dry out.

3-19

6 Take a uniform core (or thin slice) of soil from the surface to the plow depth (usually 5–6 inches). (In permanent pastures or lawns only to a depth of two inches.) If a spade and knife are used, dig a spadeful of soil to the plow depth and throw it aside. Then dig a one-half inch slice of soil and keep it on the spade.



Use a knife to cut from this slice on the spade a one-half inch core from top to bottom and place it in a clean bucket or container.



Repeat this at each of 15 to 20 spots in the area to be sampled. If using a sampling tub or soil auger, place soil from sampling tool in a bucket.

7 Mix soil well in bucket. Then take out enough to fill a carton.

8 If you are going to send sample to laboratory for analysis, be sure to label each sample and keep a record. Then fill out information sheet as fully as possible. This will help make your report and recommendations useful to you.

9 If you have the equipment for making the analysis in your laboratory you can do this. You would probably have to consult an agricultural specialist (agriculture teacher or county agent) to help you determine the amounts of plant food needed for the soil you have sampled. If you send the sample to a laboratory for analysis and request it, they will send recommendations with the results.

Send samples off for analysis or, if possible, test them in the laboratory.

The teacher now guides the discussion by asking questions such as:

1 What is the value of soil testing in crop production?

2 What is the value of soil testing in soil conservation?

3 What is the value of soil testing for soil improvement?
4 How would a good soil testing program help improve the economy of the area?
5 What are some specific ways that soil testing helps?

Students observe the following:

1 Texture of the surface soil.
2 Slope of the land.
3 Kind and density of the plants growing.
4 Mulch on the land.
5 Evidence of runoff of water the soil could not absorb.

Pupils compare soil in areas where surface soils are different. They can see what kinds of soils absorb water more readily.

They can see how slope and certain plants that provide ground cover affect the amount of water absorbed by soils with different surface textures. They are asked to observe the conditions that exist in these areas.

Extending the Concept What differences do we notice in the plants growing at the different sites? Have students look at the results of the soil tests taken from different sites. Have them suggest reasons for the differences in the growth of plants at the sites by asking questions such as:

1 What differences do you note at the different sites?
2 What are some reasons for these differences?
3 What effect do certain plant food elements have on growth of the plant?
4 What happens when a soil is different in certain plant food elements?
5 What difference do you note between the fertility levels of sandy soils low in organic matter, and loamy soils containing organic matter? Why is this so?
6 What are some things that might cause the soil to be deficient in certain plant food elements?

The class now considers how the land in each class could best be used by:

1 Farmers
2 Real estate men
3 Military leaders
4 Town and city planners
5 Public utility departments
6 Recreation specialists
7 Forest industries

Fixing the Concept Evaluate your understanding of the relationship between the types of soil, other factors, and the use of the soil.

TREES

This section contains background information and projects on the following subjects:

- Forests - Awareness of Beauty
- Trees - Story Told in a Tree Stump
- Barks Made by Trees
- Patterns in Leaves
- Out on a Limb
- Weight of Tree
- Calculating Height
- How a Tree Grows
- Forest Insects and Diseases
- Forests and Fire
- Forest Management
- Forests - Renewable Natural Resource
- Glossary

Forests—Awareness of Beauty

Concept Group living requires cooperation within and between groups in order to maintain an optimum physical, social, and cultural environment for all.

Purpose of Lesson To help students to appreciate beauty around them and to have an increasing awareness that recognition of beauty is necessary for a feeling of well-being.

Introducing the Concept Take a field trip to a wooded area.

Answer the following questions *silently*. Do not say *anything* aloud.

1 How do you feel as you stand quietly here?
2 What sounds do you hear?
3 What colors do you see?
4 What do you smell?
5 Have you felt this way before? When?
6 What do you think causes you to feel as you do?

Developing the Concept Say:

Yesterday I saw a man destroy some of my most prized and valuable possessions which I have shared with everyone who passed.

1 What were they?
2 How were they destroyed? Why?
3 What evidence have you seen that man is destroying much of our natural beauty?
4 Would other people enjoy coming to a place like this? Why?
5 Why is it not possible for all people to enjoy the outdoors?
6 What could be done to help these people?

Extending the Concept John Muir once said, "Everybody needs beauty as well as bread, places to play in and pray in, where nature may heal and cheer, and give strength to body and soul alike."

1 As you ride through the country, what things do you see that detract from the beauty?
2 How much of our land is being used?
3 In the city, are there ugly areas, or centers? What has caused this? How do you feel about it?
4 What evidence do you have that people are becoming concerned about this? How can we find out about this?

Have class collect pictures and make posters, showing the beauty and bounty of your state. Show selected *America the Beautiful* series pictures, and let pupils point out values they see in each.

Fixing the Concept Write a story on the travels of a paper plate at a picnic. Encourage pupils to plan with parents what they can do to have a woodland garden at home.

Trees—Story Told in a Tree Stump

Concept The environment shows change.

Purpose of Lesson To help students understand that there are many things that can be learned about resources by keen observation in the outdoor classroom.

Introducing the Concept "I know where there is a history book deep in the woods. You can read this book, if you are interested in the story it tells. Would you like to have a try at a history lesson in the woods?" Take the group into the woods where there is a large, old stump of a tree. This should be selected ahead of the trip to be sure it shows the history to be taught.

Developing the Concept Investigate:

1 What kind of tree was it? (If the tree shows lines radiating from the center, the tree was probably an oak.)
2 From what did the tree grow? (Acorn, etc.)
3 How old was the tree? (Count rings.)
4 Why are the rings different distances apart?
5 At what time of the year do you think the tree grew the most?
6 How can you tell when there was a good growing year? A poor growing year?

Extending the Concept Investigate:

1 What evidence can be found of animals that have visited or used the stump? (Tunnels of carpenter ants, beetles, spiders, rodents, bird droppings, partly-eaten acorns, signs of a saw or an ax.)
2 What plants are growing in the stump dust? (Ferns, mosses, lichens, seedlings.)
3 Are there any signs which tell you what may have happened to the tree?

Fixing the Concept What is the difference between a deciduous tree and a conebearing (coniferous) tree? Which was this tree? Find another tree of the same kind as this one. Sketch the shape of the tree that once grew on this stump. From the history you have read from the stump book, make the following predictions:

1 What will eventually happen to the stump?
2 List the things that might have been done with the lumber from this tree.
3 Do you see any signs of what might happen in the area where this tree once stood? (Seedlings growing from seeds of the old tree.) Teach natural reforestation.

4 Close your eyes and imagine the tree is still standing, while I read the poem *Autumn Fancies.*

Perhaps you would like to learn the poem to make it your very own. (Poem below.)

AUTUMN FANCIES

The maple is a dainty maid,
  The pet of all the wood,
Who lights the dusky forest glade
  With scarlet cloak and hood.
The elm a lovely lady is,
  In shimmering robes of gold,
That catch the sunlight when she moves,
  And glisten, fold on fold.
The sumac is a gypsy queen,
  Who flaunts in crimson dressed,
And wild along the roadside runs,
  Red blossoms in her breast.
And towering high above the wood,
  All in his purple cloak,
A monarch in his splendor is
  The proud and princely oak.

Anonymous

Barks Made by Trees

Have you ever noticed that the bark on one tree is often much different from the bark on another tree? Trees are frequently identified by their distinctive leaves, seeds, or fruit. However, during the winter these helpful clues are usually absent on deciduous trees (trees that lose their leaves in the fall). Even during the growing season these features are difficult to observe in some cases because they are so high up on the tree. For these reasons, many people have learned to recognize trees by the characteristics of the bark. This chapter suggests activities that will help you learn more about the bark of trees around your school or home. If you do these activities, you may be able to identify some species of trees by examining the bark.

Even though the bark of trees varies in appearance, it serves similar purposes. You probably know that the tough outer part of the bark protects the growing layer (*cambium*) inside the trunk and branches from insects, fungi, and other enemies. Do you know that bark has an inner part too? This layer of bark contains passageways that conduct food from the leaves to the other growing parts of the tree. Sometimes the food is stored in these channels of the inner bark.

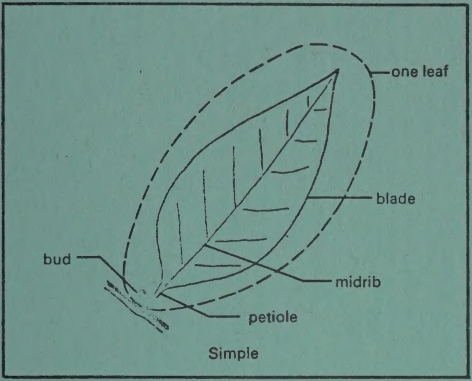
Before you start any of the activities in this chapter you should think of the things that might cause differences in bark. Some students suggested the reasons shown in the diagram for bark differences. Did you consider all of these possibilities? Did you think of some others?

Bark Differences

1. Bark might be different because the trees might be of different species.
2. If the bark on the same species of the tree is being considered, differences in bark might result from:
    - (a) differences in the age of the tree
    - (b) different sides of a tree being examined
    - (c) comparing the trunk and branches
    - (d) places where the trees are growing such as a crowded forest or an open field
    - (e) diseases and insects

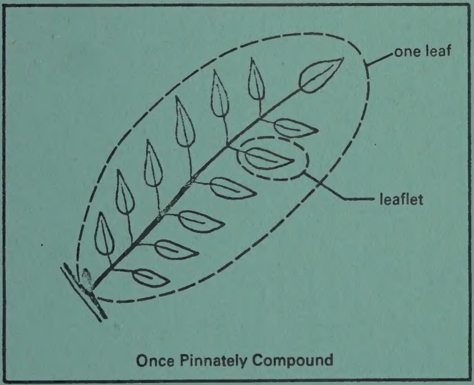
Patterns in Leaves

A simple leaf usually has one *blade, a petiole, and a bud at the base of its petiole. Sometimes stipules will appear at the base of the petiole as well.*



Simple

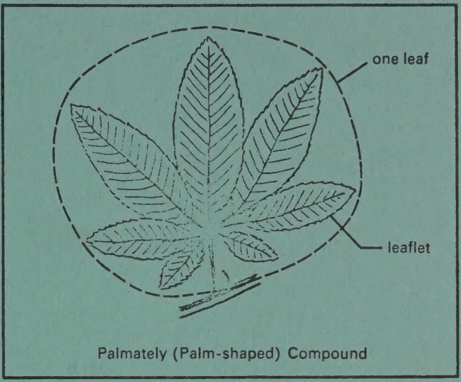
A once compound leaf has one main petiole and the leaflets are arranged pinnately or on the side of the petiole.



Once Pinnately Compound

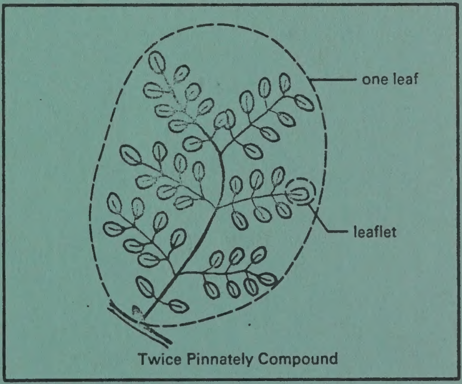
To determine whether or not you are dealing with a leaf or leaflet on a tree, there are two tests you can apply. Firstly, a leaf will *always* have a bud at its base, a leaflet won't. Secondly, a leaf will always have a circular or semi-circular base to surround the bud,

A compound leaf has two or more leaflets and a bud at the base of its petiole or stem.



Palmately (Palm-shaped) Compound

A twice compound leaf has one main petiole and then secondary petioles arranged on the side of the main petiole. The leaflets are arranged pinnately or on the sides of the secondary petioles.



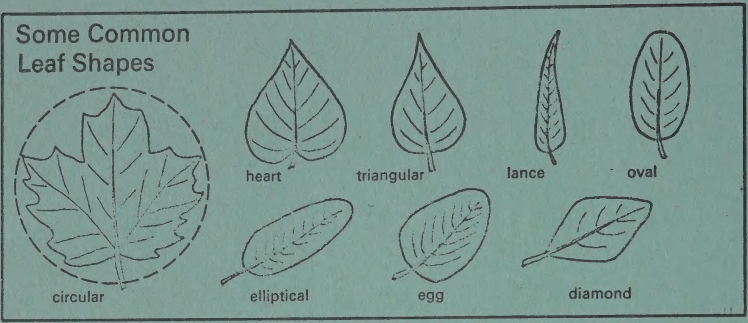
Twice Pinnately Compound

whereas a leaflet won't. The sycamore tree with its hollow petiole and some conifers are exceptions to the rule.

Survey several trees in your locality to discover whether or not they have compound or simple leaves.

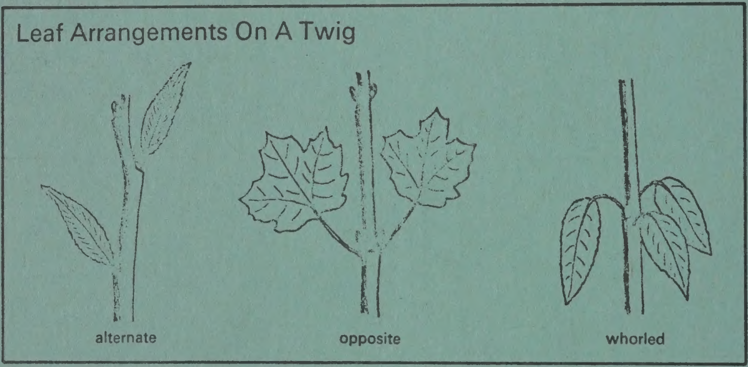
Pine needles are always in bundles of two, three, and five.

Find leaves which have these leaf shapes. Which leaf shapes are most common in your area?


Some Common Leaf Shapes

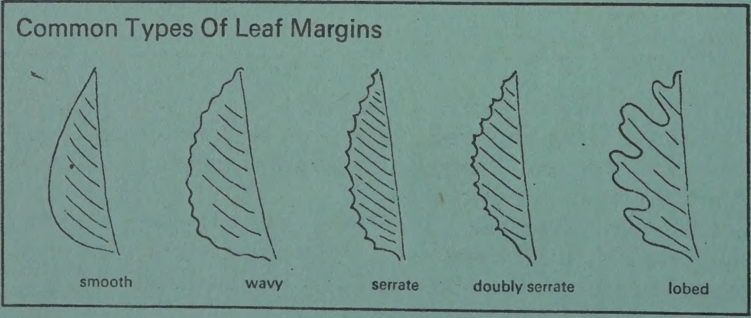
heart
triangular
lance
oval
circular
elliptical
egg
diamond

How many trees can you find with leaf arrangements like these?


Leaf Arrangements On A Twig

alternate
opposite
whorled

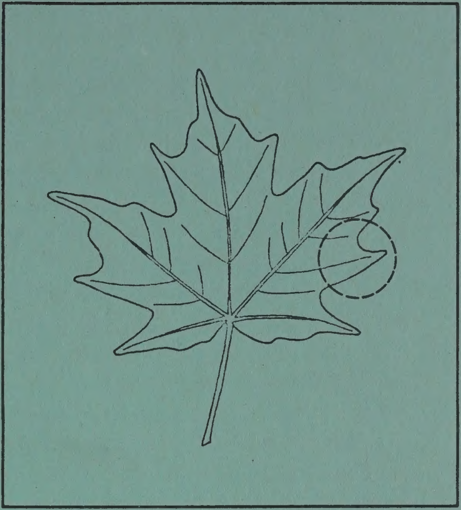
Examine a number of trees in your area to see which type of leaf margin is most common.


Common Types Of Leaf Margins

smooth
wavy
serrate
doubly serrate
lobed

A lobe has a primary vein in it. A tooth will have a secondary vein in it.

Oak leaves are an exception to the lobe, tooth rule. Since the spaces or sinuses between the teeth on some oaks run almost to the midrib of the leaf they are called lobes even though they have a secondary vein in them. Technically they are teeth but some botanists call them lobes.



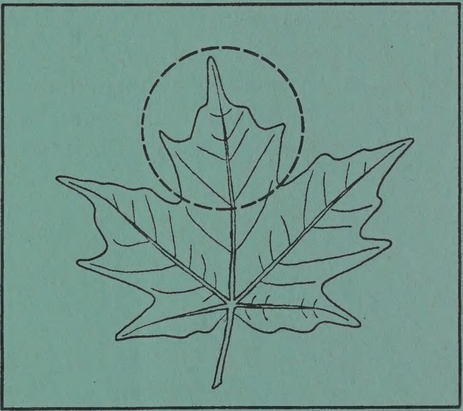
Activity 2:

How can leaves be classified?

Select a partner and with his help collect one leaf from each of a number of different trees in your neighbourhood. The leaves could be gathered in a paper bag.

Classify the leaves in any manner you wish.

Display your classification system on a bulletin board or piece of Bristol board. Remember to record the reason why each leaf is in a particular subset.



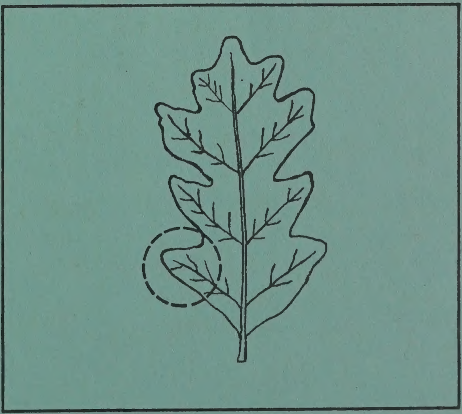
Digging Deeper

Did your classification system of leaves resemble or agree with other leaf classification systems found in reference books on trees?

How many properties did you use to classify your leaves?

What are the three basic properties by which leaves are classified?

To whom would a leaf classification system be useful?

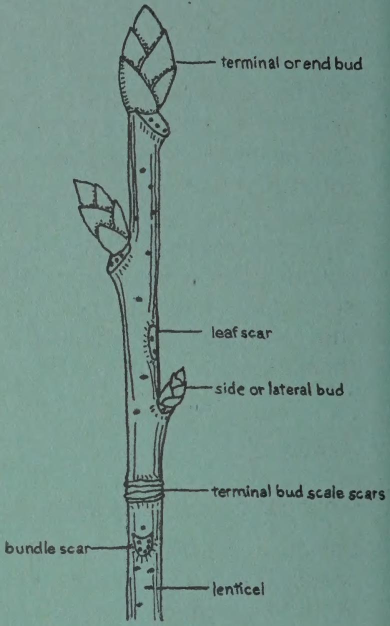


Out on a Limb

One of the most fascinating parts of a tree to research is the ends of its larger branches or the twigs. The best time to investigate twigs of deciduous trees is in the winter season when there are no leaves on them. Twigs have several outstanding features such as the *buds, leaf scars, bundle scars, scale scars, lenticels,* and color, that can be readily observed. Other outstanding characteristics can be found by cutting the twig open either crosswise or lengthwise. By doing this, the *pith* of the twig is revealed. Some twigs are also covered with interesting hairs or fuzz. Upon observing twigs you will discover other features not mentioned here.

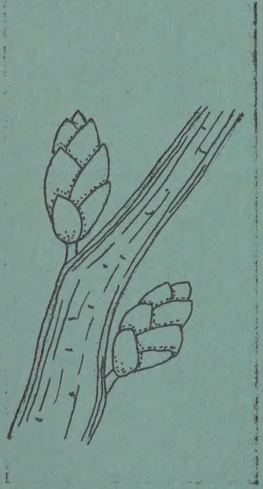
Examine the following illustrations. An understanding of the pictures and their terminology are essential to the activities which will follow later in the book.

Twig Features



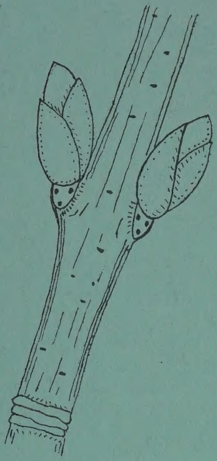
Find a twig which has some or all of the features that were mentioned.

Does a coniferous tree twig have any of these features?

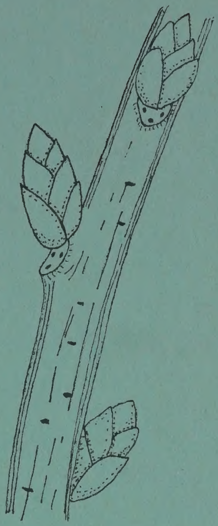


The spur, short stem, or stalk shows a variation of alternate arrangement.

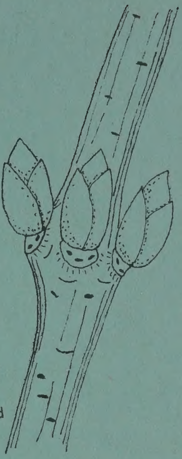
Bud Arrangements On A Twig



opposite

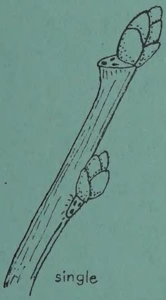


alternate

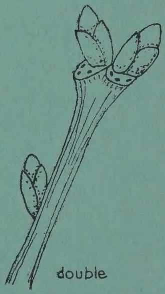


whorled

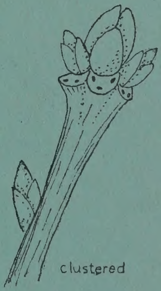
Terminal Or End Bud Arrangements



single



double



clustered

Find twigs which have the bud arrangements shown in the illustration.

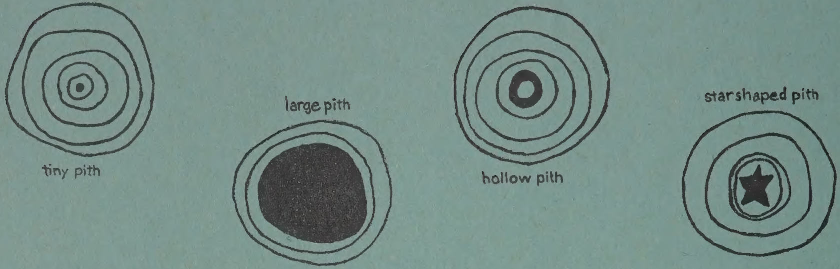
Which arrangement is most common?

Do all twigs have terminal buds?

Do coniferous trees have any of these terminal bud arrangements?

Which terminal bud arrangement is most common on coniferous tree twigs?

Pith Features



Survey the trees in your area to find twigs that display the pith features illustrated.

Which type of pith is most common?

Do coniferous trees have piths?

Twigs represent the visible growing parts of a tree. In order to grow and reproduce itself, a tree produces buds which in turn become leaves, flowers, and branches. The buds found on a twig are developed in late June, July, and August and indicate the tree's readiness for the next year's growth.

The following activities involving twigs, if done properly and with care, will reveal some very interesting features which will give you insight into the tree's growth pattern and development.

Use common sense when collecting twigs from trees. If you follow these steps the trees will not be damaged.

Use snipping shears or a knife to remove the twig from the tree.

Don't take all the twigs from the same spot or side.

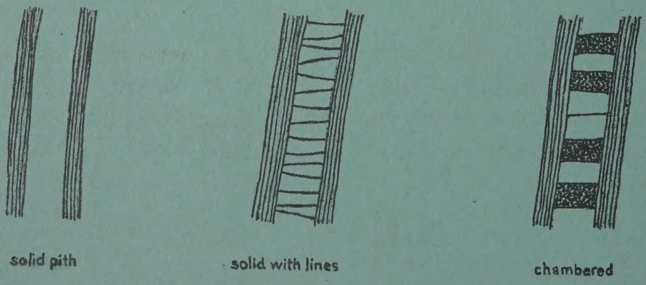
Remove twigs which won't noticeably affect the general appearance of the tree.

Label your twigs.

Store the twigs in water.

Horse chestnut, elm, beech, oak, poplar, basswood, hickory, and walnut make good specimens with which to begin your study. Caution: If twigs are to be taken from private property, permission should be obtained from the owner beforehand.

Longitudinal Sections Of Pith



Activity 1:

What are the parts of a twig?

Collect twigs 10 to 15 inches long from a tree on the school grounds or a woodlot.

Select a twig and examine it with the aid of a hand lens.

Look for the terminal bud, leaf scars, bundle scars, lateral buds, lenticels, terminal bud scale scars, color, fuzz, pith, and any other particular features not mentioned.

Use a diagram to record your findings.

Digging Deeper

What are the most noticeable features on your twig?

Are buds found on trees at all seasons of the year or only in one season?

Do all the twigs you collected have leaf scars, lenticels, buds, bundle scars, pith?

Were all your twigs the same color?

Is there always a terminal bud at the end of a twig?

What is found immediately below each bud?

How does a twig change from season to season?

Activity 2:

What is in a bud?

From the same tree pick three terminal buds and three lateral buds.

Using a taped razor blade or an injector type razor blade, slice one of each kind of bud lengthwise. Draw a picture of the bud's structure as you see it from this cut.

Cut a second bud of each kind crossways through the middle. Draw a cross-sectional picture of each.

Take the third bud of each kind and carefully pull it apart piece by piece. Lay all the parts in a line side by side. Draw and label diagrams of each part.

Digging Deeper

Are the buds hard or soft when squeezed gently?

Are the buds sticky or not sticky? If sticky, why?

Did all the buds contain the same structures, i.e., leaves or flowers?

What different parts did you find in the buds you pulled apart piece by piece?

Which buds on a twig show the greatest growth vigour?

Do all buds have the same number of scales?

Which buds develop faster, those from coniferous trees or those from deciduous trees?

Do terminal buds always contain the same structures inside them?

Which buds develop faster, leaf buds or flower buds?

List both the internal and external similarities and differences between terminal and lateral buds.

Are there equal numbers of leaf and flower buds on a tree?

Are coniferous tree buds the same as deciduous tree buds both externally and internally?

Do all buds have scales?

Activity 3:

How can the age of a twig be determined?

Obtain a twig approximately 15 inches long.

Examine the scales of the terminal bud. These scales fall off as the bud grows. Terminal bud scales leave marks on the twig each year. They usually appear as a set of lines or wrinkles around the twig. Each set of wrinkles indicates one year's growth.

Look at the section on your twig between the terminal bud and the first set of wrinkles (the *terminal bud scale scars*). This shows the amount of growth during the past year. Progress down the twig to the next set of wrinkles. This measures another year's growth.

How old is your twig?

Digging Deeper

Does the distance between sets of terminal bud scale scars change from year to year?

In which year did your twig grow the most? the least?

What factors might have caused slow growth in some years and rapid growth in other years?

Where on the twig does growth in length take place?

If your twig has a side shoot, in what year did it start to grow?

Activity 4:

How are leaf scars different?

Leaf scars are marks left on a twig by the leaf. They are found below the buds. Their shape corresponds to the shape of the base of the leaf. Leaf scars are like the tree's fingerprints. They are an invaluable aid in tree identification.

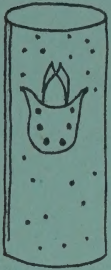
Collect twigs from several different types of trees. Examine the leaf scars with a hand lens. Washing the twigs in warm soapy water and then rinsing them in lukewarm water will aid your observation.

Sketch the dots and lines that you find on the face of each leaf scar.

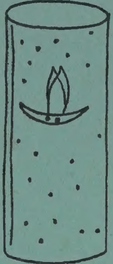
These dots and lines are called *bundle scars.* Compare them to the chart of leaf scar shapes.

Using real twigs and the photographs, try to answer the questions.

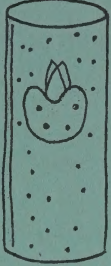
Common Leaf Scar Shapes



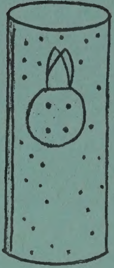
shield shaped



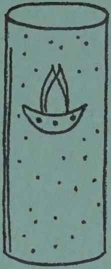
narrow



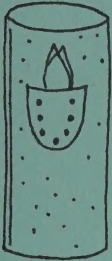
notched



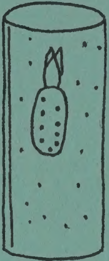
round



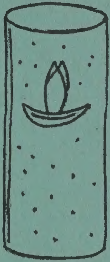
crescent shaped



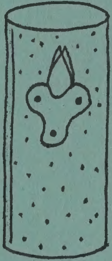
arranged in
U-shaped line



arranged in
an ellipse



single bundle scar
crescent-shaped



scars 3-distinct

Branching Out

Revisit one of the trees that you used for your study. Describe the bud arrangement on a twig.

Compare the bud arrangement to the type of branching in the tree.

Is it correct to say that the type of branching in a tree depends on the bud arrangement? Explain your answer.

On a tree with whorled branches each set of branches marks one year's growth.

Digging Deeper

Where are the oldest branches located on your tree? the youngest branches?

Which year provided the best growth for your tree? the least growth?

Compare your results with other classmates to find out which species of tree seems to grow most quickly.

How does increasing age affect your branch? Study the older and younger parts of your branch. You might devise tests to investigate differences in strength, color, texture, flexibility, waterproofness, and other factors.

4-15

In what directions do most branches of a tree grow?

Stand beside the trunk of a tree. Place a magnetic compass on a level piece of ground so that the needle swings freely. Compare the directions in which the main branches of the tree are growing to the compass directions.

Record your information.

Digging Deeper

Do more branches grow in one particular direction? If so, which direction?

Does this pattern occur in other trees of the same species?

How would other trees or objects, such as buildings, affect the branch pattern?

In what direction do the prevailing winds blow around your tree?

What evidence can you find that these winds affect the branch pattern?

What is *wind burn?*

Branching Out

Measure the length of each branch that you have charted with your compass. You might use the felling the tree method to measure the lengths of the branches. In this case, you will line your pencil up with the total length of the branch and carefully lower the pencil until the length of the branch can be marked and measured on the ground.

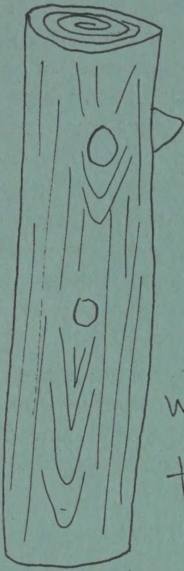
Do the longer branches grow in a particular direction? What other factors might account for any direction and branch length pattern that you have discovered.

Compare the results for your tree with the information that the other students have collected for trees of different species. What similarities and differences can you find in the branch patterns?

Make a model of your tree using drinking straws and toothpicks, plasticene and wire, or some other materials. Show the pattern of the direction in which the branches are growing and the length of the branches.

Trace the shadow of your tree on the ground at noon on a sunny day. Are all parts of the shadow the same distance from the trunk? Explain your findings.

WEIGHT OF TREE



1. I found a maple block of wood.
2. I weighed the block. It weighed 3 lb.
3. We found out how many times the block would go around the tree. It went 20 times.
4. We thought this much would weigh 75 lb.
5. We decided all the wood in the tree might weigh 3,000 lb.
6. This would be $1\frac{1}{2}$ T.

One student decided to estimate the weight of a tree. Are there any tree measurements that have not been mentioned which you would be interested in investigating?

Digging Deeper

Which layer is the dead layer of the tree?

Which layer is the growing layer?

Which layer conducts sap up and down the tree?

Of what value is the bark to the tree?

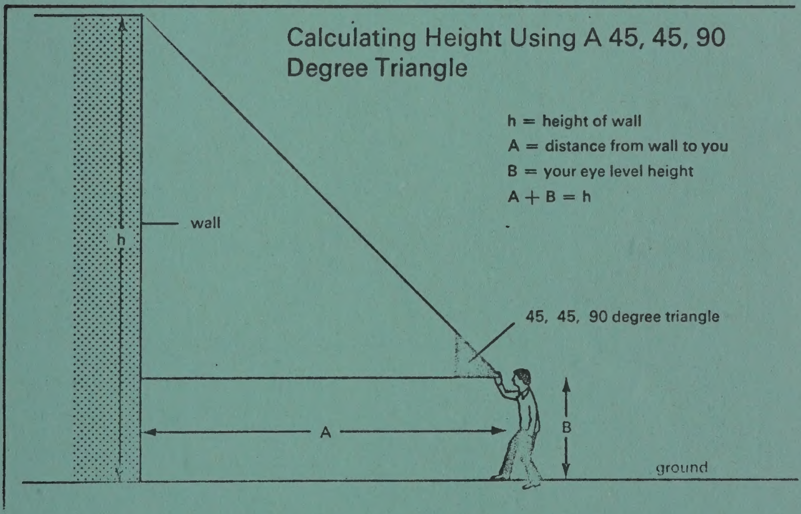
What are the rings called?

How could drought or frost affect the growth of these rings?

A forester, botanist, high school biology teacher or curator of a museum might prove to be a valuable person to consult in this exercise.

Calculating Height

To calculate height with this device, stand close to the wall of the school, and place the triangle near your eye as shown in the photograph. Sight along the long side of the triangle, and begin to back slowly away from the wall until the top of the wall comes into view. You will need someone standing at the side of the triangle to make sure that its bottom edge is parallel to the ground.



Calculating Height Using A 45, 45, 90 Degree Triangle

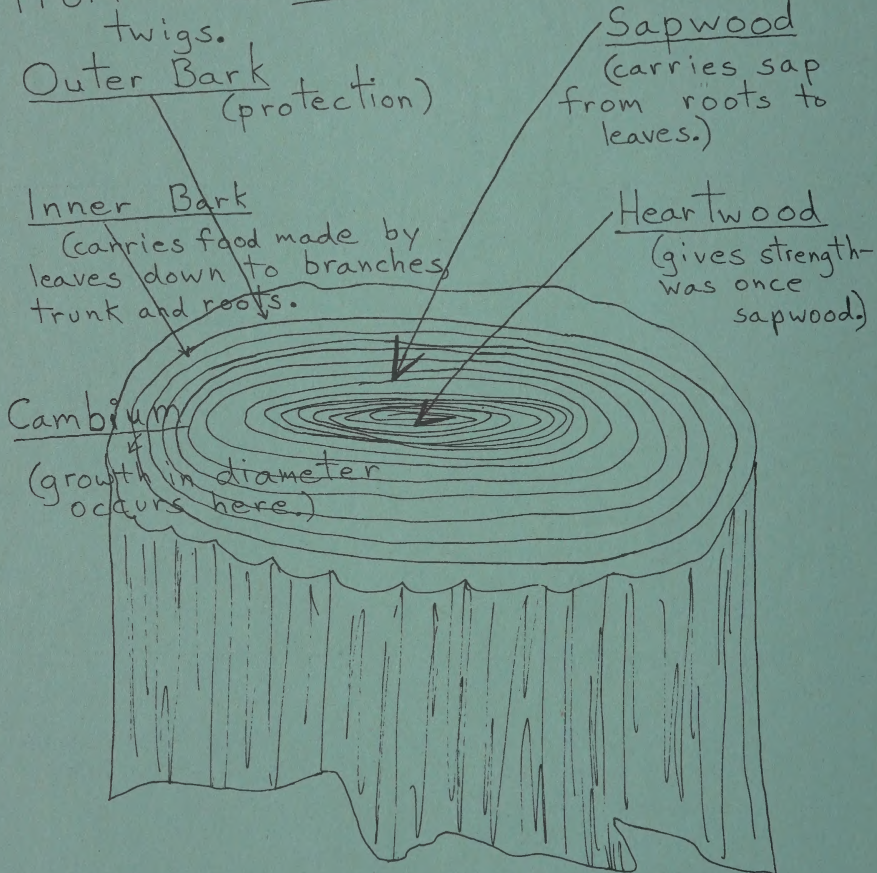
h = height of wall
A = distance from wall to you
B = your eye level height
A + B = h

You must hold the triangle in this position near your eye. The triangle must *be level.*

The height of the wall is obtained by adding A and B.

HOW A TREE GROWS

Every year new twigs grow. The tree gets taller and wider. New twigs grow from the buds at the end of twigs.


Outer Bark (protection)
Inner Bark (carries food made by leaves down to branches, trunk and roots.)
Cambium (growth in diameter occurs here.)
Sapwood (carries sap from roots to leaves.)
Heartwood (gives strength- was once sapwood.)

Could you add any information to this student's diagram?

Forest Insects and Diseases

Concept Plants compete with many forces for survival.

Purpose of Lesson To help students understand more about two of the natural enemies of the forests—*disease* and *insects.*

Introducing the Concept Prior to the field trip, select a forest area where there are a number of dead and dying trees. A forester will be able to help select an area if needed.

On the day of the lesson take the pupils on a field trip to the forest area. Ask them to observe the trees and note anything affecting their growth. The pupils observe that there are some dead trees of different ages and also there are some that appear unhealthy. What are the explanations for what they see?

Developing the Concept Pupils look for signs of insect or disease damage to trees. In making their observation, they look for the answers to questions such as:

1 What part of the bark is being affected?
2 What effect is it having on the tree's life processes?
3 How are the diseases spread? (The spores of nearly all fatal or deforming tree diseases may be carried by the wind, by birds, by insects, and by animals.)
4 Some diseases need two host plants to complete their life cycle. What are host plants?
5 What age trees are more susceptible to attack?
6 How does mechanical damage to trees affect the susceptibility of the trees to insects and diseases?
7 What are some ways trees receive this mechanical damage? (Fire, animals, logging operations, etc.)
8 What kinds of insects are attacking the trees?
9 What kinds of diseases are attacking the trees?

Only a few of the most common insects and diseases need be discussed.

Extending the Concept Show the film *Pamela's Tree* (or other film on insects and diseases that would be appropriate.) This goes into some measures that can be taken to help timber owners to save their trees. All during the lesson, pupils have been asked to observe how insects and diseases attack and destroy trees in the forest. They now consider some things that might be done to help prevent this damage and reduce losses. The teacher leads the discussion with questions such as:

1 What are some ways disease organisms and insects gain entrance into the tree?
2 What can be done to control diseases that need a host plant to complete their life cycle?
3 What are some things that can be done to help prevent insects and diseases in forests?
4 What are some control methods that may be used for insects and diseases? (Teacher will need to get the information that is applicable to the area she lives in from the forestry agency. It is made available to the pupils to help them find the answers.)

Fixing the Concept Investigate the economic loss to the state due to insect and disease damage to forests in the state.

The class now considers what action is necessary to prevent insect and disease damage to trees in:

1 The school environment.
2 The home environment.
3 Town or city environment.
4 Forests.

Forests and Fire

Concept Plants compete with many forces for survival.

Purpose of Lesson To help pupils understand the effects of fire on the forest.

Introducing the Concept Show the film *Men, Women, and Children.* This film shows how careless habits of well-intentioned people cause devastating forest fires. Pupils become aware of what a fire does to a forest. What are the actual damages fires cause and what can be done to prevent or control them? Ask pupils if they know of a forest nearby that has had a fire recently. Briefly discuss these areas and what the pupils have noticed.

Developing the Concept Take pupils on a field trip to a forest that has been recently burned (one of the ones mentioned by the students would be good). Have the pupils observe the trees growing (if any), the ground cover, organic matter, etc. The teacher acts as a guide in directing the discussion by asking questions such as:

1 What kinds of damage to the trees do you see?
2 What size trees are damaged the most?
3 How many seedlings do you see?
4 How will the damage to young trees and seedlings affect future production of trees?
5 What will result from the loss of ground cover and organic matter?
6 How do you think this fire started?
7 What could have been done to prevent it?

Extending the Concept The pupils are led in a discussion of ways that forest fires can be prevented. Topics are:

1 For smokers:
    a Be sure your match is out.
    b Use ash tray.
    c Crush out your cigarette.
    d Put your ashes in the earth.
2 Campers:
    a Clear a spot for your fire.
    b Pour water on fire and cover it with earth.
3 Brush Burning:
    a Plow or rake fire line around area to be burned.
    b Never burn on dry or windy days.
    c Make sure area to windward of fire is clear.
    d Make small brush piles.
    e Have tools and water ready.
    f Patrol all sides and stay with it until the fire is dead out.
    g Notify your neighbors and State Forest Service.

Pupils observe that when a fire does start it must be controlled as quickly as possible. This is dangerous and anyone fighting fire should know what he is doing.

There are three things a fire needs to burn—fuel, air, and heat. Remove any one and you can stop the fire. This demonstration should be carried out by the forester.

In a small area cleared of all combustible material, place three small piles of leaves or straw. Using one pile at a time, demonstrate how removal of any one of the three elements needed will cause fire to die.

Pile No. 1: Light straw on one edge, then with rake, rake away that part of the straw that is not burning. This removes the fuel and as soon as all the straw that is left has burned, the fire will die.

Pile No. 2: Light straw, then spray water on the fire, cooling down and putting it out. Here you have removed the heat.

Pile No. 3: Light straw, then using a flap such as forest fire fighters use, or a wet sack, cover the fire. This causes the fire to die from lack of oxygen.

Fighting forest fires involves using one or more of these methods. The teacher acts as a guide to the discussion of controlling fires by asking questions such as:

1 How would you remove the fuel on a large scale, as in a forest?
2 How would you make use of two or more of the principles above at the same time?

Investigate:

In the classroom the teacher lists the following questions for the pupils to find the answers to:

1 What is the economic loss in the state due to forest fires?
2 What per cent of the forest fires in the state are caused by man?
3 In what ways does man cause fires?
4 How much does forest fire prevention and control cost the state each year?
5 Does the state have forest fire laws?

After the students have found the answers, they may be discussed.

Forest Management

Concept Man is the important factor in determining the environment of the forest.

Purpose of Lesson To help students understand the effect of other plants on forest trees.

Introducing the Concept Take a field trip to a forest area and ask the pupils to observe the trees and other plants growing. What are the explanations for what they see? The teacher acts as a guide, by asking questions such as:

1 What kinds of trees are growing?
2 How many of these trees have some commercial value?
3 What species of trees growing are the most valuable?
4 What forest products are being grown?
5 Are there as many valuable trees growing as the land will support? Why or why not? How can we tell? (Use an increment borer to bore into an average tree and determine, by looking at the annual growth rings, the rate of growth. Rings close together mean slow growth, while rings wide apart mean rapid growth.)
6 What effect are the poor species of trees having on the growth of the desirable trees?
7 What are some of the major problems we find there?
    a Desirable trees too crowded?
    b Too many trees cut?
    c Not enough trees of commercial value?
    d Host plants that help spread diseases?
    e Too many large "wolf trees"? (Large trees which take up space and food.)
8 What factors determine kind and number of trees the land will support? (Climate, soil, water, etc.)

Developing the Concept What can be done to improve growing conditions for the more desirable trees? The teacher guides the pupils into finding some of the answers by asking questions such as:

1 What can be done where the valuable trees are too thick?
2 What can be done when there are weed trees?
3 What are the methods for getting rid of those weed trees?
    a Mechanical?
    b Chemical?

(This information can be obtained from the forestry agency in each state or from the county agricultural extension agent.)

4 What can be done when there is a poor stand of desirable trees?
5 Where can a forest owner get information and help with his forestry problems?

Extending the Concept The class considers what needs to be done to help valuable trees successfully compete with other plants and produce to their maximum potential.

Fixing the Concept

Ask:

1 Why is the squirrel hunter unhappy when you take out the "wolf" oak trees?

2 Would a wildlife manager interested in improving the environment for deer manage this forest in the same way?

3 What about the quail hunter?

4 What about the person who is only interested in beauty?

BASIC CONCEPTS

A tree is a woody plant with a single stem or bole. It has a fairly well defined crown or top and is 20 feet or more in height at maturity. For a while after a man is born, he is called a baby. Then he passes through the stages of being a boy, a youth, a young adult, an adult, and finally an old man. There are similar growth stages for a tree. A tree is first a seedling. Then it becomes a sapling, then a pole. Next are the stages of early maturity, maturity, and over maturity.

Growth of a tree is in height and diameter. The bud at the tip of the main stem or leader elongates to add to the tree's height. Division and growth of cells in the cambium layer that is between the bark and the wood cause the tree's diameter to increase. (Underground the roots elongate through growth activity at the root tips and the roots grow in diameter the same as the stem and branches.) As a tree grows in height and diameter, the volume of its trunk increases. Thus, tree growth is commonly expressed in terms of wood volume measurements: board foot, cubic foot, and cord.

Forest growth or stand growth is the sum of the growth made by all the individual trees that are large enough to be considered. Forest growth or stand growth is expressed in terms of board feet (or cubic feet or cords) per acre.

Site is an expression of productivity of the land, its potential for tree growth or wood production. Climate and soil are the major influences on site. Temperature, precipitation, and length of growing season are the climatic factors that help govern site. Elevation has an influence on site because it affects climate. Depth, fertility, texture, structure, water holding capacity and pH are soil characteristics that affect site. A common expression of site is the height that dominant trees of a given species will attain at a specified age. For example, good site for western white pine is land where the dominant trees of this species will reach 60 feet height at 50 years of age. Average site for the same species will grow trees that are 49 feet tall in 50 years, and on a poor site western white pine reaches a height of only 39 feet in 50 years.

A forest is a community of living organisms covering a fairly large area. Trees usually are the dominant kind of vegetation. A forest uses air, water and earthy materials to grow, attain maturity and reproduce itself. The forest organisms sometimes compete with each other for food materials, moisture and growing space. The weaker organisms often die because they cannot successfully compete with their stronger neighbors. Sometimes forest organisms complement each other, or they help each other out. An unmolested forest is always moving toward greater harmony with its environment and a better balance among its organisms. A forest is capable of furnishing mankind with many valuable products and uses. A small forested area is usually called a woodland or woodlot.

Forest interrelationships - We have said that a forest is a community of organisms. In a forest interactions are going on continually between organisms of the same species and between different species. There interactions involve all forms of life in a forest, from the bacteria in the soil to the loftiest trees that grow.

Soil is one of the factors that dictates what kind of a forest will grow on an area. The forest slowly but constantly brings about change in the soil. The leaves, twigs and decaying bodies of forest plants add to the soil's depth and fertility. The penetration of plant roots and addition of organic matter improve soil structure, increase the rate of moisture penetration into the soil, and improve the soil's capacity to hold moisture.

Moisture, the amount and pattern of annual precipitation, helps determine the type of forest that will grow on an area. The forest in turn has an effect upon the amount of moisture that reaches the soil, upon the percolation rate of water into the soil, the rate of snow melt, and the seasonal rate of flow or discharge of streams. Because a forest holds the soil in place and gives it a protective covering, the quality of water from forest land is high.

Forest openings may provide abundant food for wildlife or domestic livestock, and heavy forest cover provides good animal shelter. If seed production and germination conditions permit all openings in a forest to become seeded in with a dense stand of young trees, then the lower shrubs, forbs and grasses are mostly shaded out; and the larger wildlife species may then have a poor habitat in that forest.

The management of a forest for multiple-use benefits depends upon our knowledge of these interactions. We can in most cases manage a forest for the timber and yet keep the soil almost as well protected as under an unmolested forest. We can manage for timber and still have just as high a quality of water and possibly even greater quantity as from an unmanaged forest. In most cases timber management improves the forest from the standpoint of wildlife habitat. And timber management need not greatly deter (in fact may even improve) the recreational benefits from the forest.

Management brings change in a forest faster than nature will make the change herself. For example, if a stand of young trees is too thick, nature gradually thins the stand. But if the stand is managed, the needed thinning can be done quickly and the trees selected to leave will grow faster as a result. In a managed stand trees can be grown to the same size in 60 to 80 years that they would be in 100 to 120 years without management.

Change is slow in an unmanaged forest, but it is always in one direction: toward the most mesophytic vegetation the area will support. This means that change will keep going on until the types of plants growing on the area are those with the highest moisture requirements that can be satisfied by the soil and the precipitation. In some of the lodgepole forest around camp, you may notice that the young trees are mostly alpine fir rather than lodgepole. This is an indication of change toward a different type of forest community - a more mesophytic one. When such change has progressed to the point where the plants in a forest are those with the highest moisture requirements the area will support, then the forest is said to be climax, in equilibrium with its set of growing conditions, or its site.

Forestry is the effort occupied with the management of lands for the continuous production of wood and forest uses (grazing, recreation, etc.) that are beneficial to mankind. Forestry is the science, art and business of growing trees and converting them into products for our use.

Policy for any enterprise, public or private, is the goal of management. Policy defines what we are trying to accomplish through management. The stated policy of the U. S. Forest Service for many years has been "to manage the national forests for the greatest good to the greatest number of people in the long run". Public forest policy in general is still the same but is usually stated in terms of gaining the maximum in multiple use benefits from our forest lands--i.e., manage for water, wildlife, recreation and forage values as well as for timber. Private forest policy in general is to manage the timber for the greatest economic return that is consistent with the conservation of these other benefits from the forest lands.

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FOREST MANAGEMENT

The management of a forest, no matter what its size, seeks to answer three questions:

1. What is the resource that we have to work with?
2. What can we do with it?
3. How are we going to do what needs to be done?

There are several steps or phases to management that help answer these questions. To answer the question "What is the resource?", the first thing we do is to make a forest inventory. This is the process of finding out what we have. Information is needed by the forest land manager on:

species: The kinds of trees that are growing in the forest. Species must be recorded as they occur on various areas or sections of the forest. Are they the ones most adaptable to the area? Are they the most valuable of the adaptable species?

site or productivity: The whole forest has to be classified by areas, units or sections according to the timber production potential. This is because different areas of land vary in their timber production potential. General site classifications are excellent, good, fair or medium, and poor. Site classification on a given area is not the same for all species. For example, an area that is excellent site for western white pine may be poor site for ponderosa pine.

age classes: Ages of trees in a forest must be known. On some areas in a forest there may be trees of all ages from starting seedlings to overmature trees. Such a stand is called "all-aged." On many areas conifero trees will start in abundance following logging or fire. Most of the tre on such areas vary from each other only a few years in age. The forest stands on such areas are called "even-aged." In making inventory of a forest, the age classes of the trees on the various areas in the forest are recorded. Age of young stands is important in management; age of very old stands may have little value in management.

stocking: We have a full stand of trees when there are enough stems uniformly distributed on an area to make complete use of the growing space. Such a stand is called fully stocked. If there are not enough trees to make full use of the growing space, the area is understocked. The stocking on such an area is expressed as a percent of full stocking. For example, if a stand is 65 percent stocked, that means only 65 percent of the growing space is being used by trees.

Here is an important fact concerning stocking: The percent of stocking depends upon the size and the distribution of the trees on an area. To illustrate, if we had 100 ponderosa pine trees that average 6" d.b.h. uniformly distributed on one acre, the stocking would be 27 percent. If all these trees grew to be 10 inches d.b.h., our stocking rate would be 62 percent. And if all the trees continued to grow to 14 inches d.b.h., the acre then would be fully stocked, or 100 percent.

Stocking rate is also related to species. On one acre uniformly stocked with 10 inch d.b.h. ponderosa pine, 160 trees would be about the optimum number of stems for best individual tree growth. Due to differences in growth habits and growing space requirements among the species, we would have 220 western white pine, 185 Douglas-fir or western larch and 260 lodgepole pine for the same level of stocking of 10 inch trees.

Forest stands often are overstocked. Overstocking is a situation where there are more trees than can do well. They compete with each other for soil moisture and nutrients with the effect that individual trees make slow growth. In heavily overstocked stands the trees will mostly still be of small diameter even when they are mature in age. It is not uncommon for overstocked lodgepole pine stands to reach maturity without producing any trees that are large enough for sawlogs.

Stocking rate of a forest is quite an important factor in its production. Therefore, the forest manager needs information on stocking rate. This information is obtained in making the forest inventory.

growth rate: Growth has to be sampled in inventory in order to know the current production of a forest. Also, growth predictions usually are made for 10 to 20 years in the future to help determine anticipated yields of products. There are several methods of determining forest growth. One of the simplest is to obtain the individual growth on a sufficient sample of dominant and co-dominant trees to obtain a reliable mean. Then convert this to growth per acre through multiplying it by the number of dominant and co-dominant trees per acre.

merchantable volume: The forest manager needs to know what merchantable products he has by species and quality. This would be the board feet of sawlogs and veneer logs, cords of pulpwood, numbers of poles, Christmas trees and other products that are available for harvest. Such information enables him to plan cutting in line with markets and management objectives.

There are different methods of making volume inventories. All depend (except for small forest areas) on taking sample plots, measuring the volume on them, and converting the sample volume to an estimate for the total forest volume. The plot sampling can be done by use of aerial photographs or through location of actual plots in the forest.

stand conditions: In making a forest inventory, information is recorded on various items that have to do with stand condition. The quality of the timber (limbiness, taper, decay, etc.), the incidence of insect and disease damage, the amount of logging debris, standing dead timber that constitutes fire risk, and the prevalence or lack of reproduction. Information on such items help evaluate the general vigor and productivity of a stand and denote the practices that are needed for improving the stand condition.

topographic features and existing improvements: The inventory should supply information on location of ridges and drainages, slope of the land, rock outcrops and other such features that would influence the location and construction of forest roads and trails. Closely related is the type of soil, especially with regard to its erodibility. Steep topography, rock outcrops and erodible soils make road and trail construction more costly. They generally increase the cost of applying all management practices.

other values: The forest inventory should supply information on the other resource values of the forest. What is the importance of the forest (or parts of it) for watershed? for outdoor recreation? as a habitat for wildlife? for the production of forage for livestock? The forest land manager always has to consider what effect timber management will have on these other resource values that usually are present. The better information he has on them, the more accurate can be his judgment concerning their treatment in relation to management of the timber.

summary: Much of the forest inventory information is ordinarily summarized on a map. Aerial photographs are often used as base maps. The map and accompanying data summary sheets give the forest species (or types), stocking, volumes, growth, slope, soil erodibility, drainages, roads, and other information collected in the inventory that is needed in preparing the management plan.

MAJOR PROBLEMS FACED BY

FOREST LAND MANAGERS

The problems listed here do not confront all forest land managers with the same intensity. For example, forest land managers in one area may have a variety of markets, while in another area they may have markets for only one or two major products. However, the problems we list here are important to a large number of forest land owners and managers in Idaho and across the nation.

The Long Period Involved in Growing Tree Crops: This is a problem of all forest land managers. Even if one grows Christmas trees, the period of waiting from planting or seedlng to harvest of the crop is several years. For sawtimber the period is usually from 60 to 100 years or longer. This long waiting period makes the investment return from forest management usually quite low. The main way that managers cope with this problem is to keep stands well spaced and in vigorous condition so that the trees will put on rapid growth and will reach the size to make the desired products in as short a time as possible.

Fire, Insects and Disease: These three major destructive agencies have to be guarded against continually. A serious fire may damage or completely destroy the forest crop on an area. Insects and diseases, when they become epidemic, can kill trees in devastating amounts. Prevention is the best solution to this problem. Educate other users of forest land to be extremely careful with fire. At all times keep on the alert for signs of insect or disease outbreak. Be prepared to reach and put out fires while they are still small. In like manner be prepared to take control action against insect and disease outbreaks before they reach epidemic proportions.

Age - Class Distribution: Many forest holdings have too much area in timber of the same age class. For example, a woodland owner is managing his land on an 80 year sawlog rotation. Three-fourths of his land has timber that is in the 70 year old age class. One-fourth is covered with reproduction averaging 10 years of age. It is quite clear that this owner does not have a distribution of age classes in his timber that will enable him to make a periodic harvest which would enable him to have a fairly regular income from his land. If he could have about 10 percent of his land in the stage of having a tree crop at the age to be harvested and re-established, 10% at about age 70, 10% at about age 60, 10% at 50, etc., he would then have regular harvests that could be made and thus have regular income. Managers have to extend the cutting age on some areas and reduce it on others during a period of years until they can get their lands into a balance of age classes that will sustain regular cutting.

Erosion, Non-Restocking, Watershed Damage: Most forest soils are shallow when compared to good agricultural soils. Forests often grow on steep slopes. Forest land managers often have to plan ahead carefully when logging some areas to prevent serious soil erosion and consequent watershed damage. Also, when soil is lost, restocking or re-establishing a forest stand becomes more difficult. Non-restocking may become a problem without erosion. If a good seed crop does not soon follow logging, brush may take over the logged area and make the establishment of young trees extremely difficult. Careful layout of logging roads, skid trails and landings is the manager's main method of coping with this problem. Helicopters, skyline, and balloon logging may be the ultimate answer.

Lack of Markets: This is a problem mainly of small woodland owners. They often do not have volumes of products sufficient to enable them to do other than sell to established markets. Therefore, they often have to let high quality logs go at average log prices, or trees that would make other products of higher value have to be sold on the sawlog market. Small-private forest owners in some areas have formed marketing co-operatives through which they get the advantages of higher prices for large volume sales, sorting of products, and grading. Forest co-operatives have not been very successful in this country, but a few have shown that the co-operative approach can help very greatly to solve the marketing problems of small woodland owners. Some co-ops have provided management assistance to members.

Wildlife and Domestic Animal Use: In some areas deer and elk damage young trees to the point that they are deformed in shape or killed. Bears do significant damage especially to young hemlock in Oregon and Washington coastal forests. Porcupines damage trees, mainly pine species, of nearly all sizes throughout the west. Gophers, mice and rabbits are sometimes very destructive to seedling-size trees. Cattle, horses and sheep damage young trees through trampling, browsing and rubbing. The damage by domestic livestock can be controlled by regulating the grazing use. Various means are taken by forest managers to control wildlife damage. Porcupines, mice, rabbits and gophers have sometimes been poisoned. Valuable game animals, such as deer and elk, are usually controlled through regulation of hunting pressures. This problem is one that the forest land manager cannot easily handle by himself because game animals in most of the west are considered public property. Therefore, the control has to be in a manner acceptable to the public.

Social Problem: The general public does not fully appreciate the problems faced by forest land managers. Many forest visitors are not careful about smoking or about attending their campfires. Forest fires frequently result from such carelessness. A forest land manager may have an area of timber whereon the best harvesting practice would be clearcutting. Yet he may be severely criticized for such a practice by an uninformed public who thinks he has utterly destroyed the forest resource. So you can see that the forest land manager's job will be easier if the public can be helped to understand his problems.

Overstocking and Understocking: Most of our forest stands in this country have resulted from natural reproduction; that is, seed from trees left on or around logged areas have fallen on the ground, germinated and started a new crop of trees. Natural regeneration may result in a stand that has far too many stems per acre for the trees to be able to make good growth. In such case expensive thinning operations are necessary if the forest is to give good production. On the other hand, natural regeneration may not result in enough trees for a good stand. In such case artificial seeding or planting is needed to bring the stand to full stocking. In either case (thinning or planting) the expenses incurred must be carried many years before there are marketable products that can be sold from the stand. This comes back to what we said earlier about the long waiting period causing the investment returns in forestry to be low.

Forests—Renewable Natural Resource

Concept The forest is a renewable natural resource.

Purpose of Lesson To help students understand that the forest is a renewable natural resource.

Introducing the Concept Show the film *Heritage Restored.* It tells the story of early use and abuse of forest lands in the eastern United States, and how passage of the Weeks Law in 1911 put 20 million acres of this land under protection as National Forests. Today these public lands are restored and productive. Pupils find out about the abuse of the forest. What are the reasons why this happened? Is it happening today? Where?

Developing the Concept How can we find out if it is happening today? To do this the pupils are taken on a field trip to several forest areas. (If available, secure a forester to go along as a consultant.)

Here they observe the reproduction and growth of the forest. To help pupils understand that the forest is a renewable resource, the teacher acts as a guide by asking questions such as:

1 What is this land best suited for?
2 What has man done to make the forest more productive?
3 What can man do to make the forest more productive?
4 What has man done that may have hindered forest production on this land?

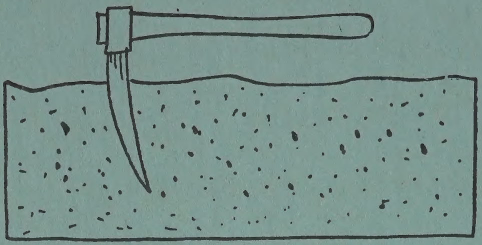
The discussion should be guided so that the pupils understand that with proper attention and careful management practices, the amount of timber cut on an area over a period of time will be replaced by an equal amount of growth.

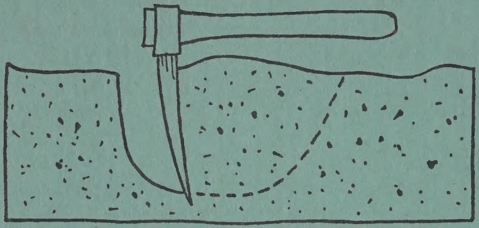
Extending the Concept During the lesson pupils have been asked to observe how nature provides for sustained (continuous) yield forestry. They should be given an opportunity to discuss how man can help, rather than hinder, this process. (A forester should be used as a consultant, if possible.) The teacher asks questions such as:

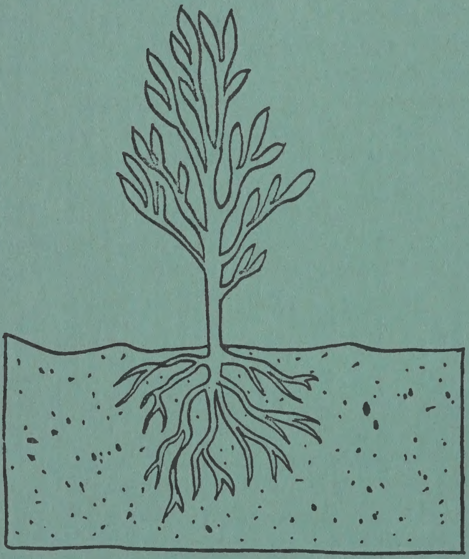
1 Who is the first to benefit from a well-managed forest?
2 What are the management factors that must be considered and how should each be handled?

Pupils are asked to observe the forest land in the community during the next few days and consider what needs to be done to improve the production.

The teacher should encourage the class to take a small area and plant some trees.







Write to your state forestry agency for information on tree planting, and the best kinds of trees to plant in your area of the state.

Fixing the Concept The class considers what needs to be done to insure that our forests are maintained as a renewable resource and allowed to produce to their maximum potential.

Trees—A Renewable Resource

Concept Trees are a resource which is renewable. People, regardless of age, have a responsibility to conserve and renew this resource.

Purpose of Lesson To help children understand the intangible value of trees—shade, protection, homes for animals, and beauty, as well as the importance of providing trees for the future.

Introducing the Concept Take an early fall tour of the schoolgrounds to make an inventory of the number and kinds of trees on the grounds. (End with the group being seated on the ground in the hot sun, not under a shade tree.) Complaints about the direct heat from the sun will set the stage for introducing the lesson.

1 Where would we be more comfortable? Why? Send a child to get a thermometer to measure the temperature. Assign a group to determine the temperature in the sunshine where they are sittting.
2 Close your eyes and imagine the schoolgrounds, your yard, or the park without trees.
3 How does the ground where you are sitting look?
4 Do you see any signs of birds or animals living here where we are?
5 Let's find a place to sit under the trees. (If trees are not available on the schoolground take a walk into a wooded area.)
6 How do you feel now?
7 What is the difference in the temperature under the trees and the temperature in the sunlight?
8 Do you see any signs that make you think that birds and animals might live in the trees?
9 Pick up a handful of soil. How does it look and feel?

Developing the Concept Inquire of the children:

1 How old are you?
2 How tall are you?

It took you seven years to grow as large as you are. Trees grow slowly also. You stop growing when you are 5 or 6 feet tall but trees grow on until they sometimes reach a height of several hundred feet. What kind of trees grow the largest and live the longest? (A committee may be appointed to get this information from the library and report.) Go again to the grounds to determine which trees make the best shade. A resource visitor from the State Forestry Commission might advise about the best species of shade tree for this area.

3 How do we know this is the best tree for giving us shade, furnishing homes for animals, and help for the soil?
4 Do they grow slowly or rapidly?
5 We do not know many things about trees. Who can help us? Show the film *The Tree on the Road to Turntown,* or similar film, to show the length of time necessary for growing a tree.

Extending the Concept Use a resource person to talk with the children, answer their questions, and advise them about kinds of shade trees to plant in this area.

1 How can we find the age of the trees on the schoolground? The Forestry Commission can furnish charts on HOW A TREE GROWS and a cross section of a tree showing how age can be determined by counting the rings.

2 If someone had planted a tree 25 years ago where you are sitting today in the sun, how would you feel today?

3 How can you make it possible for children 25 years from now to have a cool, relaxing, and happy place to play?

4 How can you provide a home and protection for birds and squirrels?

5 How can you help the soil to be cool and woodsy?

6 Where else can you plant a tree for the same purpose?

Forests as Crops

Concept The economy of a region depends on the utilization of its resources and technology.

Purpose of Lesson To help students understand how growing trees fits into the total crop production program in this country.

Introducing the Concept Show the film *Deep Roots*. It is an account of the pine forests in the south and stresses the development of tree farming to conserve our forest resources. Pupils gain some insight into where trees should be grown and why. (Some excellent slides on land use changes are also available from Harvard Forest Museum, Petersham, Massachusetts.)

Developing the Concept A field trip is taken through the forest and along the way the pupils stop and discuss what they see. The teacher acts as a guide, by asking questions such as:

1 What is an area of land, such as this, best suited for? Why?
2 How could better use be made of this land?
3 What is the most intensive use that could be made of this land?
4 What are some forest products growing here?

The answers to the questions would probably be different at the sites, due to the differences in the land (slope, fertility) and the differences in the stand of timber and the kinds of trees growing.

Extending the Concept The pupils are now taken to some areas where the land is not suited for crops and there are no worthwhile trees growing. Here the teacher guides the discussion by asking questions such as:

1 What is the value of this land for crop production?
2 What is the value for producing forest products?
3 Who would benefit from developing the area into a forest?
4 How would they benefit?
5 How would developing a forest help conserve natural resources? What resources?
6 What kinds of forest products could be grown here?

Fixing the Concept During the lesson, pupils have been asked to observe the forest and to see the kinds of land on which forest products are produced.

They now consider what needs to be done to increase production of forest products, especially on land not suitable for other crops. The teacher assigns topics for the students to report on, such as:

1 What is the economic value of the forest industry in the state?
2 How many people are employed in this industry?
3 What per cent of the forest land is being used wisely?
4 What are the biggest conservation needs in the forest industry?

Students make reports to the class on the answers they find.

Forests and Man

Concept Plants compete with many forces for survival.

Purpose of Lesson To help students understand the effects of man's activities on forests.

Introducing the Concept Take the class on a field trip to several forest areas that show evidence of man's negligence and abuse. The areas should be some that show evidence of:

1. Wasteful and destructive cutting or logging operations, evidence of trees having been cut that should not have been cut, thereby leaving a poor stand and damage to trees that were left.
2. Uncontrolled or wild fires—90 per cent are man-caused. (Controlled fire may provide valuable food for wildlife.)
3. Over-grazing and browsing by animals.
4. Logging having been carried on or stopped during the wrong season of the year, thereby inviting insect attack.

Pupils compare the growth of the trees in the forest. What are the explanations for what they observe?

Developing the Concept The teacher acts as a guide to help the pupils find out how man has influenced our forests by asking questions such as:

1. In areas where poor cutting practices have been carried on:
   - a What evidence of poor cutting practices is observed?
   - b What effect will this have on future production?
   - c What influence will this have on disease and insect damage later? Why?
   - d How does this contribute to making the forest more vulnerable to fire?
2. In areas where fire has burned in recent years:
   - a What effect did the fire have on the forest?
   - b What evidence do you observe that would indicate that the fire was caused by man, directly or indirectly? What was the purpose for burning?
   - c How will it affect future production?
3. In areas where there is evidence of grazing or browsing by animals:
   - a What effect are the animals having on growth of trees?
   - b What effect are animals having on seedlings and saplings?
   - c How good is the grazing?
4. In areas where logging stopped during wrong seasons:
   - a What effect did this have on infestation by insects and diseases?

Extending the Concept Show the film *Easier Ways of Logging*. This film gives attention to the use of proved methods of logging for greater efficiency, and good forestry as an aid to better wood production.

During the lesson pupils have been asked to observe how man, through his carelessness and thoughtlessness, has abused one of our natural resources. They now consider what could be done about this. The teacher asks questions such as:

1. What precautions should man take when cutting forest products?

2 What precautions should he take against uncontrolled or wild fire?
3 What can man do to help reduce damage from insects and disease?
4 What precautions against over-grazing?

A field trip is taken to a well-managed forest. Pupils observe the practices being carried out and the results that are evident. Questions are asked:

1 What is the evidence of good cutting practices?
2 What kind of protection do we have against fires? Over-grazing or over-browsing animals?
3 How does the production here compare with other areas we have observed?

Fixing the Concept The class considers what action to take to make citizens aware of how their carelessness is affecting our forests and what can be done to encourage them to be more considerate when working or playing in or near forest areas.

GLOSSARY

allowable cut: The timber volume that can be cut on a forest area during a given period under a specified plan of management for sustained production.

bark: Protective covering of a tree. Inner bark: The layer of bark next to the wood. It can be recognized by being more moist and less corky than the older bark. Outer bark: Those layers of bark that are drier and more corky or porous in appearance than the bark that is next to the wood.

basal area: The sum of all the cross-section areas of living trees at breast height, expressed in square feet per acre. Thus, a forest stand with 160 square feet basal area per acre is one wherein on the average the breast high cross-section areas of all live trees on an area total 160 square feet.

board feet: A measure of lumber, defined as a piece of wood 1 foot long, 1 foot wide and 1 inch thick. Of course a board foot can have different shapes. A piece of wood 2" x 6" x 12" contains one board foot, as does a piece that is 1" x 4" x 36". The formula for calculating the board feet in a squared timber or piece of lumber is:

$$\text{board feet} = \frac{\text{thickness in inches x width in inches x length in feet}}{12}$$

bole: The central stem or trunk of a tree.

bucking: Sawing felled trees into the desired lengths for transporting.

cambium: A thin layer of cells located between the inner bark and the sapwood on trees. The cambium cells divide, some become bark and others make wood. It is through the activity of the cambium that tree trunks and branches grow in diameter.

canker: A wound on the stem or branch of a tree caused by the activity of a disease organism, such as the white pine blister rust fungus.

catface: A flattened and usually faulty area on the trunk of a tree. Catfaces result from injuries caused by fire, logging damage, disease action and other agents.

choker: A length of cable with a self-tightening or sliding noose on one end. The noose is fastened around a log or logs and the other end hooked onto a tractor or other skidding device for dragging logs out of the woods to the landing.

climax: With reference to forest vegetation, climax is the most moisture-loving forest type that an area will support, or it is the forest cover that is most nearly in equilibrium with its environment.

coniferous: An adjective meaning cone-bearing. Coniferous trees, or conifers, are all those trees that bear cones as fruits. Practically synonomous with evergreens and softwoods.

cord: A stack of wood that is 4 feet high, 4 feet wide and 8 feet long, or it is 128 cubic feet of stacked wood volume. On the average, a cord contains about 85 cubic feet of solid wood. The other 43 feet is taken up in space between the sticks. It is generally considered that one cord of wood is the equivalent of 500 board feet.

crown: The branch-bearing portion of a tree. Sometimes the branches in the lower part of the crown are dead; hence, the term "living crown" is often used to designate only the part of the crown where the branches are still alive.

crown classes: A classification of forest tree crowns with respect to their positions in relation to each other in a stand. Dominant trees are the tallest trees in the stand. They are able to get direct sunlight from above and from one or more sides. Codominants are about the same height as the dominants. The codominants get direct light from above, but are so crowded by other tree crowns that they get little light on the sides. Intermediate trees are not quite as tall as the dominants and codominants, but they are still able to get some direct light from above. Suppressed trees have had the crowns of others close above them so that they get no direct sunlight. Dominants will usually have the broadest, longest and most vigorous looking crowns. Codominants have good crowns, but they are not usually as broad as the dominants.

Intermediates have very narrow crowns because they are crowded severely from all sides. Suppressed crowns often are flat-topped and partly dead.

cruise: An estimate of the timber volume on an area of forest land, or the act of obtaining the data to make the estimate.

cubic foot: A measure of wood, defined as the solid wood contained within the dimensions of a cubic foot. Pulpwood and other forest products that are not sawed into lumber are frequently measured in cubic feet.

cull: Any tree, log or other forest product that is rejected because of quality or size.

Cutting: Removing trees from a forest to make salable products or to improve the stand, or both. There are several methods of cutting. Under management the one method judged to be best for the health and growth of any residual stand and for getting reproduction of the species desired is the one usually selected for use.

clear cutting: Taking all trees regardless of whether or not they are merchantable. In other words, clearing the area. Clear cutting is usually done in strips or blocks. Often the clearcut areas are control-burned to get rid of slash. Then they may be planted, seeded or left to regenerate naturally. Lodgepole pine and overmature western white pine are the two Idaho species that respond best to clear cutting. In overmature, decadent forests clearcutting is the only feasible means of harvesting and regenerating the timber.

group selection cutting: Taking out groups of trees so that openings 1/4 to 1/2 acre in size are made in the forest. This method is often used on mature ponderosa pine.

improvement cutting: The main objective is to improve the growing conditions, health and quality of the stand. Normally an improvement cutting mainly takes out defective trees: those with broken tops, forked tops, leaners, diseased, fire scarred, etc.

partial cutting: Only part of the merchantable volume is cut. The trees may be selected individually and marked for cutting, or in some stands all trees above a minimum diameter limit may be cut. Usually from 30 to 60 percent of the total volume is removed in a partial cutting.

release cutting: A cutting method used in stands that have not reached maturity, and in stands where young trees have come in under the residual from a past cutting. In either case, crop trees are selected. Then trees that are competing with the crop trees are cut. This "releases" the crop trees. Sometimes the word release is used to denote removal of brush or weed trees to give young seedlings more chance to grow.

salvage cutting: Taking out dead timber or green timber that has been seriously damaged by insects, disease, fire, wind or other agents. A salvage cutting is logging to save usable wood volume that otherwise soon would be rendered useless by death and/or decay.

sanitation cutting: About the same as an improvement cutting. A sanitation cutting usually removes diseased or insect susceptible trees in order to improve stand health and reduce the risk of loss of these factors.

selection cutting: A partial cutting wherein the trees to be cut are selected or marked. The trees selected for cutting may be on the basis of crown vigor, species, size or combination of such factors.

shelterwood cutting: Another form of partial cutting. As the term implies, enough of a residual stand is left to provide ground shelter. This method works well to get reproduction of those species that like some shade.

deciduous: Refers to the annual shedding of leaves. Deciduous trees are those that shed their leaves each fall.

d.b.h.: Diameter-breast-high. The d.b.h. of a tree is its diameter outside the bark at 4 1/2 feet above the ground.

d.i.b.: Diameter-inside-bark. The d.i.b. in log scaling always refers to the diameter inside the bark at the small end of the log.

falling: Cutting down trees, or making them fall.

felling: Used sometimes to mean the same thing as falling.

forest land: Commercial forest land is that which is capable of growing continuous wood crops under present economic conditions. Non-commercial forest land is incapable of growing continuous wood crops under present economic conditions due to low productivity or inaccessibility, or land that has been reserved for some purpose that prohibits its use for timber growing.

evergreens: Trees that retain their leaves or needles more than one season. Hence, they always bear live foliage and are called evergreens. The term is practically synonomous with conifers and softwoods.

gooseneck: Undesirably long leader growth in a Christmas tree the second growing season prior to its harvest.

growing stock: All live trees except cull trees of the commercial species from seedling to sawtimber size.

growth, net annual: The average annual net change of volume in sawtimber or all growing stock usually calculated from the total change over a 10-year period. It is the volume gain over losses to natural causes, exclusive of catastrophic losses.

gyppo: A contract or piece-work logger. The term is rather generally applied to any contractor or worker in the forest industry who is paid on piece-work basis. As a verb, it means logging or doing other work on contract or piece-work basis.

hardiness: The ability of trees and other plants to withstand winter temperatures.

hardwoods: The broad-leaved or deciduous trees. It does not mean that the wood is hard. Some species of the hardwood group, such as aspen, have softer wood than species of the softwood group, such as western larch.

heartwood: The inner part of a tree trunk wherein the wood cells have ceased to function in the life processes of the tree. In most species the heartwood has a darker color than the sapwood layer that is between the heartwood and the bark.

increment: growth. Forest increment, stand increment, annual increment all would mean the same if we substituted the word growth.

increment borer: A tool used to sample tree growth. It contains a case which also serves as a handle, a hollow auger and a thin strip of metal (crescent-shaped in cross-section) called a core remover. With an increment borer one can remove a small core of wood from a tree and on it count the annual growth rings.

intolerant: A word used to denote tree species that will not withstand or tolerate heavy shade. Intolerant species need full sunlight for best growth. Lodgepole pine is an intolerant species.

jammer: A machine used for skidding and loading logs. A jammer usually consists of a single boom or gin pole, or an "A" frame which is equipped with a system of pulleys, cables and drums which enables running a line out to where a log lies, fastening it to the line with tongs or a choker, and skidding it into the landing. The whole assembly is ordinarily mounted on an old truck.

leader: The height growth made at the top of a tree's main stem during the latest growing season.

loader: A piece of equipment designed for loading logs on trucks or railway cars. Frequently loaders are booms or hoists mounted on a truck or tractor chassis.

log rule: A formula or diagram method for estimating the board-foot contents of logs. There are many log rules. Scribner Decimal C Rule is the official rule for Idaho. The International Log Rule is the most accurate for all sizes of logs.

marking: Designating trees for some purpose (usually for cutting) by painting, branding, blazing or other suitable means. Painting by use of a special marking gun is the most common method.

mature: Trees go a life cycle like all living organisms. Mature trees are those that have reached the stage where growth rate has slowed down, the tops become flattened rather than pointed, branches become gnarled and the crown foliage begins to thin out.

merchantable height: That portion of a tree's total height that can be used for the products being harvested. Merchantable heights of sawtimber are usually expressed in the numbers of logs that can be cut from the trees to the acceptable minimum top diameter.

merchantability: An expression of the standards a tree must meet in order to be salable according to the buyer or according to agreement between buyer and seller. For example, a timbersale contract might specify trees that have at least 14 inches d.b.h. and two 16 foot logs to be merchantable.

mortality: Death loss in forest stands due to insects, disease, fire and all other natural factors. Man-caused mortality is tree death loss due to man's activities, such as logging, burning, spraying, etc.

multiple-use: The principle of managing forest land for the several values or benefits they are capable of producing. When forest land is managed for the best combination of watershed values, wildlife habitat forage production, recreation benefits and timber, we have multiple-use management. Nowadays a new term "balanced use" means about the same thing.

over-mature: The stage in a tree's life when it gradually weakens due to the natural infirmities of old age.

pith: The growth center of a tree stem or branch.

poletimber: This is a general size and/or volume class for timber stands. Pole-size timber is usually defined as being between 5 inches and 10 inches d.b.h. Poletimber stands are those stocked with trees 5 inches d.b.h. and larger but with less than 1500 board feet volume per acre. The term poletimber is also sometimes applied to stands of western redcedar, western larch or lodgepole pine wherein the trees are large enough to make utility poles.

pruning: Removal of limbs from the boles of trees in order to produce knot free or clear timber. Basal pruning denotes removing some of the lower branches from Christmas trees in order to slow down height growth.

regeneration: Renewing the forest or establishing a new crop of seedling trees after a forest crop has been logged or destroyed by fire, wind or other destructive agents. Regeneration is natural if it comes from seed dispersed by trees left on the area or surrounding it. Artificial regeneration is when man distributes seed or plants young trees to start a new forest.

reproduction: Seedlings and young trees up to several inches d.b.h. are commonly called reproduction. The term also has meaning the same as that given for regeneration.

residual: The trees that are left after logging.

sapling: A young tree between 1 inch and 5 inches d.b.h.

sapwood: The outer layer of wood around a tree trunk that is still active in the life processes of the tree. Sapwood is usually lighter in color than heartwood and normally has a higher moisture content.

sawlog: Actually any log that a mill will take for sawing into lumber is a sawlog. In Idaho a sawlog is usually thought of as being 16 feet 4 inches long and at least 8 inches d.i.b. at the small end. Smaller diameters are commonly accepted from second-growth trees, especially from western white pine. In some localities the term long logs has come to mean logs 33 feet long. They are actually two 16 foot logs left together for convenience until they arrive at the mill. Another term, stud logs, is commonly used in localities where there are specialized sawmills that saw only 2" x 4" studs. Stud logs are 8 feet 3 inches in length and usually a minimum 6 inch top d.i.b.

sawtimber: A forest stand that will yield a cut of at least 1500 board feet of sawlogs per acre, or those trees in a forest that are large enough to make sawlogs for the markets of the area.

scaling: Measuring logs with a special scale stick to obtain an estimate of their board-foot contents.

scarring: Shaving the bark from one or more sides of the lower trunk of a Christmas tree in order to slow down growth.

seeding: Distributing forest tree seed on an area in order to establish a stand of trees.

seedling: A small tree, usually thought of as being less than 1 inch d.b.h.

shearing: Trimming, cropping or clipping back the terminal leader and the lateral branches on Christmas trees to get better form and more density in the crown. Leader shearing refers to trimming only the leader of a tree. Fork shearing is a method of trimming back the tips of the lateral branches to the first or second set of side branchlets. Plain shearing is trimming the lateral branches to improve form without regard to the positions of the side branchlets.

silvics: The branch of forestry knowledge that deals with the effects of site on the occurrence and growth of forest tree species, site requirements of species, and with the effects of forests on site.

silviculture: The knowledge and the practice of regulating forests from establishment to harvest and regeneration through protection, thinnings, cuttings and other measures to get the best yields possible.

skidders: Men and machines used to drag logs from where the trees are felled to the landing--the point where they are loaded for hauling.

skidding: Dragging logs from where the trees are felled to a landing or loading point. Crawler tractors, or "cats", rubber-tired wheeled skidders, and jammers are most commonly used for this job. Horses formerly were widely used for skidding logs but now only occasionally.

skidroad: A route followed only by tractors or horses for the purpose of skidding lobs. Skidtrail is a synonomous term.

slash: The tops, limbs that were trimmed off, and cull portions of trunks of trees left in the forest after logging.

snag: A standing dead tree. Ordinarily snags are dead trees that have been standing long enough after dying that most of the limbs have dropped off. Dead trees that have not reached this stage are just dead trees, or brushy snags.

snagging: Falling or dropping snags on an area to reduce fire risk. This is a measure commonly taken before planting.

softwoods: The conifers. Generally synonomous with evergreens. In general the wood of softwoods is softer than that of hardwoods, but it is not true in all cases. For example, western larch, a softwood, has harder wood than cottonwood or aspen which are hardwoods.

springwood: That portion of the annual growth ring which is laid on during the flush part of the growing season. It is less dense and usually lighter colored than the summerwood portion.

stagnation: A condition reached in a forest stand where the trees are competing so keenly with one another that they make very slow growth. Stagnation most commonly occurs in even-aged stands on poor sites.

stand: The combined lot of trees growing on an area. There are all kinds of forest stands: young, old, even-aged, uneven-aged, decadent, overmature, immature, stagnated, etc.

stem: The main trunk or bole of a tree. Sometimes the word stems is used to mean trees, as so many stems per acre.

stocking: The extent to which growing space is used by trees of commercial species. Commonly expressed in percent; that is, a stand with 75% stocking has enough trees to use effectively 3/4 of the growing space.

summerwood: The more dense and usually darker colored portion of the annual growth ring that is formed during the latter part of the growing season.

sunscald: Damage to the cambium and consequent killing of the bark by the sun's heat. A rather common injury that happens when sense stands of young timber are opened up so that the sun strikes directly on the stems of the residual trees.

sustain production or sustained yield: Management of our forests in such a way that the flow of products and services from them does not diminish.

terminal bud: The bud that is located on the tip of the main stem or leader of a tree. The terminal bud will elongate during the next growing season to make the tree's height growth and the lateral buds located just below the terminal elongate to form a new whorl of branches.

thinning: Taking some trees out of crowded stands in order to have more adequate growing space for the trees that are left. Weeding is thinning while the trees are still quite small, less than 2 inches d.b.h. Pre-commercial thinning is done before the trees are large enough to make any salable products. Commercial thinning is that which is done after the trees are large enough to be merchantable. Crown thinning is when most of the trees cut are in the dominant and codominant crown classes. Low thinning is when most of the trees cut are in the intermediate and suppressed crown classes.

trunk: The central stem or bole of a tree from the ground level to the tip.

volume table: A table that gives volume of trees according to species, d.b.h. and heights. The volume may be expressed in board feet, cubic feet or cords.

waste: In logging waste occurs any time that merchantable material from cut trees is left in the woods. This is waste in the economic sense. There is no economic waste when there is no market for cut material left behind in logging, but there may be conservation waste. For example, let's say a forest owner cuts a young stand for sawlogs and that on the average only 2/3 of the volume of each tree is acceptable as sawlogs. To leave 1/3 of the cut volume in the woods to decay certainly is conservation waste (for that hardly could be termed wise use of the timber resource) but it is not economic waste if the owner has no market for the upper, smaller portions of the tree trunks.

weeding: Thinning in a stand of very small trees, usually carried out to favor the most valuable species in the stand.

weed trees: Those trees that have little or no economic value. Therefore, the space they occupy in a forest is waste space from the standpoint of timber value, just as the space occupied by weeds in a cultivated field is waste space from the standpoint of the agricultural crop value.

whorl: A year's set or layer of branches that develops on most conifers from a ring of lateral buds located on the leader just below the terminal bud.

wolf trees: Large, limby old trees with wide-spreading crowns, usually standing alone and towering above the surrounding trees. Open grown trees that get started well ahead of the rest of the stand often develop into wolf trees. Also, rough, limby trees passed by in logging are often called wolf trees in relation to the young stand that later develops. Wolf trees usually have little value due to their large limbs and rapid taper in their boles.

witches broom: A dense, abnormal branch growth in a tree crown. Dwarf mistletoe causes a lot of brooming. Similar growths are caused by a few fungus diseases and occasionally by insects that damage the shoots or leaders of young trees.

yield: The return from or production of the land in terms of timber or other resources. Timber yield is expressed in terms of board feet or other measure per acre according to species and site. Normal yield is the production of the natural stands, without management except for protection.

PLANTS

This section contains concepts to present to students concerning:

- Plant Communities
- Wildflowers - Conservation

Plant Communities

Concept Plants grow in communities. Environment determines the kinds of plants which grow in the plant community.

Purpose of Lesson To help students understand that plants in one community differ from plants in another community because of the effect of the environment.

Introducing the Concept Several days before the lesson is to be introduced, display in the classroom two jars of water. In one jar place a piece of elodea, duckweed, or anacharis (water plants). In the other jar place a plant which normally grows in soil (bean plant, zinnia plant, coleus, geranium, etc.) When a definite change is seen in the plant which normally grows in soil, call the attention of the group to the fact. What is the condition of the geranium plant? Why?

Developing the Concept Investigate:

1 Will the geranium plant grow in regular soil?
2 Will the elodea grow in soil?
3 What other kinds of plants do you know that you would like to try to grow in water? (Cactus, etc.)
4 Have pupils bring plants from home.
5 What other plants would you like to try to grow in soil? (Water lily, etc.)

Extending the Concept Take a field trip for the purpose of observing and investigating plant communities. This trip could begin in the schoolyard and extend to fields, woods, pond, and boggy areas.

1 Are the plants different in varying locations?
2 Were the plants in the pond larger or smaller than the plants growing in the soil? Why were the plants different?
3 Do you think the fact that plant life is different in different communities would mean that the animals in the two communities would be different? Why?

Bring back to the classroom at least three plants found in the water, three found in the soil in the woods, and three plants from a dry rocky hillside.

4 Put one of each kind of plant in water.
5 Put one of each kind of plant in soil.
6 Leave one kind of each plant out of water and soil.
7 Observe what happens to all plants.
8 Why did some plants not live in water?
9 Why did some not live in soil?
10 Why did some die out of water and soil?

Fixing the Concept This will be an excellent time for pupils to set up an aquarium. Follow directions for making a balanced aquarium. After the experiences with the plants they will know which plants will live in water. Label this a *Water Community*. Children should set up a terrarium to illustrate what they observed about plants which grow in soil. It is suggested that they use one terrarium for a "woodsy" garden and another for plants which will grow in dry sandy soil. (Cactus, and succulent plants.)

Importance of Plants to Balance in the Community

Concept All living things depend upon the environment for life.

Purpose of Lesson To help students understand the interdependence of living things.

Introducing the Concept A field trip is taken, since this is the best way to study plants in their environment. Pupils can make a list of plants found in the community. (Teacher should be fully aware of local and state laws and regulations concerning picking of wild plants.)

Developing the Concept Ask pupils to list and classify as many wild plants as possible that are found in the community.

1 What are the names of the plants?
2 How does the pupils' list compare with the state listing?
3 Were all of the plants found? Why not?
4 Which plants are most abundant? Why?
5 What benefit are plants in maintaining balance in the community?
6 Which plants are native?
7 Which have been introduced and why?
8 What problems have arisen from the introduction of the new plants?

Extending the Concept As the lesson progresses, the pupils are asked to study a particular plant in the field and do research as to its origin, use, particular structure, fruit, flower, etc. and report to class.

Are the needs of wild plants in their environment different from those of cultivated plants?

Show film relating to plant conservation.

Ask pupils to find out how plant life has been destroyed in the community. What have been the results?

Fixing the Concept Discuss with your class pros and cons of making a wildflower collection. Keep in mind state and local laws.

1 Are these laws justified?
2 Should they be changed in any way?
3 Is the taking of plants for scientific study justified?

Wildflowers—Conservation

Concept Respect for the outdoors increases when its beauty is recognized.

Purpose of Lesson To help children discover, explore, and be aware of the richness of our natural environment, and their responsibility to preserve it for following generations.

Introducing the Concept Show slides or a film showing wildflowers that may be found in your local area. These may be obtained from local garden clubs or persons interested in wildflowers.

Discuss with students:

1 What is a wildflower? (Any plant which grows without the aid of cultivation.)
2 Where do these flowers live? (Swamp, sand, woodland, or others.)
3 When do they bloom?
4 Why should we leave them? (Hard to transplant; won't last long after they are pulled; continued blooming depends on reseeding of themselves.)

Developing the Concept Take a field trip to an area where some wildflowers may be found. Look for flowers, but do not collect them. Help children to know which kinds are scarce and should be left to grow. (This information may be secured from the Conservation Committee, The Garden Club of America, or from local or state garden clubs.)

Discuss:

1 How is the wildflower adapted for survival?
2 How will you be able to identify these flowers?

Extending the Concept Use a hand lens. Help students to see best means of identification:

1 How many various flower parts does the wildflower have?
2 What are their positions?
3 Are they jointed or separate?
4 What is the shape of their leaves?
5 Are their margins toothed or not?
6 Is there a presence or absence of hairs?

(A handbook on wildflowers will aid in identification.)

7 What is one great enemy of the wildflower? (Fire—destroys and burns up humus in soil.)
8 What wildflowers form a ground cover and help prevent soil erosion? (Ferns, moss, etc.)
9 Discuss poisonous wildflowers (berries, bulbs, leaves, seeds, stems, roots).
10 Find out the flower emblems for each state.
11 Prepare dried arrangements, using weed stalks.

Fixing the Concept Make a chart listing:

1 Wildflowers to protect and save.
2 Wildflowers which may be picked in moderation.
3 Wildflowers which may be picked freely.

(Find out what is being done in your state, in the nation, to encourage preservation and conservation of our wild plants.)

5-4

INSECTS

This section contains concepts about:

- Insects and Their Value to the Environment

Insects—Value

Concept Insects contribute to a balance in nature.

Purpose of Lesson To help students understand the value of insects in maintaining the balance in nature.

Introducing the Concept *First Day:* Have a praying mantis in an insect cage in the science corner. Sign above cage: Is the praying mantis a helpful or harmful insect? A box labeled, *How Much Do You Know?*, containing questions about insects, will be sure to stimulate interest in same and serve as a review of insects. Suggest that each pupil find the answer to one of the questions. (See list below for example of questions.) To introduce the lesson, present a banana and ask the question: Would you have been happy if this were the only choice of fruit for breakfast this morning? This would have been about the only choice, if there were no insects. Your choice of vegetables for lunch would be limited possibly to corn, if certain insects were extinct. Why is this true? (Ask for reports and answers to questions and research about the relationship of insects to fruits and vegetables.) Ask children to bring other praying mantises to be kept in the insect cage.

Examples of questions for the *How Much Do You Know?*

1 What are the characteristics of an insect? (Three body parts, six jointed legs, three or four life stages, etc.)
2 Why isn't a spider an insect? (Has two body parts, eight legs.)
3 How do you know the praying mantis is an insect? (Has three body parts, six legs, etc.)
4 Why was the praying mantis brought to the United States and from where did it come? (Brought from the Orient to kill insects that injured shade trees.)
5 What does "arthropod" mean? (Jointed legs.)
6 What is an entomologist? (A person who studies insects.)

Developing the Concept *Second Day:* What did you learn about insects from your study? (Reports, etc.) From the number of mantises in the insect cage there will likely be some eggs produced. Put the eggs in a terrarium. (Egg cases may be purchased from a scientific supply company, if none are produced.)

1 What food will the praying mantises need? (Cockroaches, grasshoppers, etc.)
2 How is this insect helpful to man?

Raising a family of praying mantises can become an exciting adventure and keep the interest in insects going. Rearing silkworm moths is also an effective learning experience.

Assemble equipment for field trip to collect insects. Provide for keeping some insects alive to study, and for killing some to be mounted and preserved.

Extending the Concept *Third Day:* Field Trip—purpose: To observe and collect insects to be studied. Collection should be made in habitats which are different. (Fields, woods, near water, etc.) Insects may be killed in killing jar immediately, or taken back to the classroom alive in insect cages. Instructions for working with insects can be found in the Boy Scout Merit Badge Series on insects.

Fixing the Concept *Fourth and Fifth Days:* Insects mounted, classified, exhibited.

From your reading and research, which insects have you found to be harmful? Why were they considered so? (Termites may be grown in classroom as example of insect which can be harmful.) When are termites considered to be helpful insects?

Divide class into groups to make posters showing how insects are helpful. Examples:

1 Pollinators (bees).
2 Soil conditioners (ants).
3 Predators (praying mantises).
4 Weed destroyers.
5 Manufacturers (silkworm, bees).
6 Food (bird food—eaten by people in some countries).
7 Scavengers (flies).

FUNGUS

This section develops the concept in the following projects:

- Fungi - Mushrooms
- Fungi - Bacteria, Molds, Yeast

Fungi—Mushrooms

Concept Fungi contribute to the balance of nature.

Purpose of Lesson To help children understand the value of fungi, and the part they play in the balance of nature.

Introducing the Concept *Exhibit:* Provide an edible mushroom, a dried shelf or bracket mushroom, and a fancy colored variety. Over the exhibit print ANIMAL, VEGETABLE, OR MINERAL? In which category do you think these fungi belong?

Developing the Concept Take a field trip to study fungi.

1 Which plants do not contain chlorophyll?

2 Where do fungi grow? (On live plants, dead plants, animals. Notice where they are growing.)

3 What color do you expect the fungi to be? (They can be white, gray, brown, pale pink, violet, yellow, orange, and red.)

Take collecting boxes. Collect carefully so as to protect the spores for further study: mushrooms, puff balls, etc. Point out the fungi on dead trees and logs and their importance in causing decay. Describe the woods as they would be if none of the fallen trees or branches ever decayed.

4 How many kinds of fungi are there?

5 Why are the fungi important?

6 How do the mushrooms reproduce?

7 Are all fungi helpful? (Be sure one specimen collected is complete so that mycelium, etc., can be shown.)

Place the mushrooms collected on exhibit. Form a committee to identify and label specimens.

Extending the Concept Make spore prints. Cut the cap off the mushroom, place it with gills down on a sheet of paper. Why is it necessary to use both white and colored paper? Cover for 24 hours with a glass dish and allow it to remain undisturbed for a day. After carefully lifting the cap, ask:

1 What makes the print you find on the paper? (Spores.) Spray with colorless lacquer. Look at the spores under a microscope.

2 How many cells do the spores have?

3 Are fungi affected by light or darkness? By heat and cold? Water or lack of it?

4 Would you expect to find mushrooms on the freezing shores of the arctic circle or the hot, dry desert?

5 Since fungi do not manufacture their own food, why are they classified as plants and not animals?

Make large drawing of mushrooms, puff balls, smut or other fungi observed or collected. Write to the U. S. Department of Agriculture in Washington, D. C., for information regarding plant parasites and saprophytes. Report to the class any interesting facts you discover.

Fixing the Concept What is the role of the fungi in the balance of nature?

Fungi—Bacteria, Molds, Yeast

Concept Fungi contribute to the balance of nature.

Purpose of Lesson To help children understand that bacteria, mold, and yeast are simple, non-green plants, with no roots, stems, or leaves, which live in colonies almost everywhere and depend on other organisms for food.

Introducing the Concept On the science table have a sample of mold on bread, cheese, jelly, and a piece of leather.

1 Review the difference in the plants known as fungi and other plants.
2 What did you find to be the food supply of the fungi we found in the woods?
3 The fungi which feed on living plants are known as parasites. Can you find out what fungi that feed on dead and decaying plants are called?
4 Did you see plants in the woods other than the mushrooms, etc., which belong to the fungi family?

Observe the mold on the articles on the science table with a hand lens. Some of the group may wish to make slides to be viewed under the microscope. (Previous experience will make this possible.) Divide the class into three groups to find out about mold, yeast, and bacteria.

1 Where will these fungi grow?
2 In what temperature will they grow best?

Try growing mold on many different things.

Developing the Concept How do fungi reproduce? (Spores.) Fill a balloon with small balls of cotton. Blow up the balloon. Stick a pin in it and observe how the cotton balls are scattered. The balloon represents the spore case and the cotton balls the spores; demonstrate how spores attach themselves to bread, etc.

Molds:

1 What did you learn about the penicillium mold?
2 How is the medicine used? Report on Alexander Fleming.
3 Are all molds the same color?
4 Do we at any time eat molds?

Yeast:

1 Can yeast plants be seen?
2 What shape are they? (View under microscope.)
3 How do yeasts help us?
4 How can the rising of dough be controlled?
5 How are yeasts harmful at times?

Bacteria:

1 How do bacteria help us?
2 What are some diseases caused by bacteria?
3 How can the growth of bacteria be controlled?
4 What are some undesirable results of the growth of bacteria?

Extending the Concept The action of bacteria and other plants and animals is one of the most important factors in soil formation. (The teacher should draw, from the students' experience, illustrations of the enrichment and formation of soil by the use of organic materials.) Take a trip into the woods to observe leaf mold, humus, or good topsoil.

Fixing the Concept Why should a person always wash his hands after working with mold, yeast, or any of the fungi?

WILDLIFE

The following presents background information and projects for the teacher's use concerning:

- Wildlife as Part of Our Environment
- Animals - Communities
- Wildlife Conservation
- Idaho Deer
- Animals of Idaho
- Game Birds of Idaho
- Fish

WILDLIFE AS PART OF OUR ENVIRONMENT

I. Wildlife is a renewable resource if properly managed.

  A. Surplus may be harvested each year.

II. Wildlife is a valuable resource to Idaho.

  A. People enjoy observing wildlife in its natural habitat.
  B. Provides healthy outdoor recreation in the form of hunting, fishing and photography.
  C. Brings over 60 million dollars income to Idaho each year from hunters and fishermen.
  D. Fits into most environmental situations in some way.

III. All living things have four basic needs.

  A. Food
    1. Must be available year around, particularly during winter.
    2. Must be plentiful and of good nutritional quality.
  B. Water
    1. Different amounts for different species.
    2. Some get all they need from eating succulent vegetation.
    3. Good quality is essential.
  C. Shelter
    1. Must be available year around, particularly during winter and spring nesting season.
    2. Provides protection from predators and weather.
    3. Must be adjacent to a water and food supply.
  D. Space
    1. All creatures need "elbow room," some require much more than others.
    2. Some wildlife can live in close contact to man. Some cannot.

IV. Wildlife is a product of the land.

  A. Wildlife is a crop. It depends basically upon topsoil for existence, as do all living things including people.
  B. Soil produces plants which provide food and shelter for all. Plants → plant eaters → insects or other animals → meat eaters → soil → plants, etc. Each provides food for other species.
  C. Good soil and water conservation practices are essential to maintain wildlife.

V. The way man uses land and water and the direct product of these resources determines kinds of wildlife surviving.

  A. Abundance or scarcity is also influenced by way land and water is used.
  B. Examples:
    1. Water pollution destroys fish.
    2. Overgrazing by livestock (and sometimes big game) deteriorates watershed and is detrimental to fish.
    3. Burning of willows, weeds, brush, etc., destroys food and shelter, particularly for game birds.
    4. Drainage of marsh areas eliminates waterfowl production and resting and feeding areas.
    5. Dredging of streams destroys fish habitat.

6. Road construction along mountain streams often destroys fishing.
7. Irrigation often reduces fishing streams to mere trickle, causing loss of fish. Many fish go out irrigation ditches and die in fields.
    a. Irrigated croplands provide good habitat for pheasants.
8. Improper use of insect and weed killing chemicals sometimes kill wildlife, particularly fish.
9. Improper logging practices detrimental to some species, particularly fish.
    a. Proper logging provides clearings which often benefit wildlife. These clearings often grow food, with nearby forests offering shelter.
10. Dams often block migration of fish, particularly salmon and steelhead.
    a. Reservoir often creates favorable conditions for trash fish to multiply.
    b. Reservoir sometimes floods out important big game winter range.
    c. Occasionally they provide improved conditions for fish.
    d. Sometimes provide resting areas for waterfowl.
11. As man uses more and more land for towns, farms, highways, reservoirs, summer homes, mining, recreation, etc., there is less and less left for wildlife.

VI. Wildlife is a crop and the surplus should be harvested each year.

A. Sportsmen take surplus that nature would remove by starvation, disease, etc.
B. Better for surplus to be utilized by man for sport and food than wasted by nature.
C. Harvest of surplus means more food on the range so those left will be healthier and more alert. They will also produce more and healthier young.
D. Overpopulation of big game can cause damage to its own food supply, to livestock forage, and to the watershed.

VII. Future of wildlife.

A. More and more hunters and fishermen each year.
    1. In 40 years 10 to 40 times as many as today.
    2. They will have more money and better equipment.
    3. They will have more time.
B. Try to produce more hunting and fishing for more hunters and fishermen, and do it on less land and water.
C. If we are to keep wildlife we must give it consideration in setting up uses of land and water.
    1. We need to keep well-informed on developments affecting wildlife.

Animals—Communities

Concept Animals live in communities. Environment determines the kind of animals which grow in the community.

Purpose of Lesson To help students understand that animals found in one animal community differ from those in another community because of the effect of the environment.

Introducing the Concept It is supposed that the group has discovered in a previous lesson that plants live in communities and that one community differs from another because of the effect of the environment. It is suggested that a bowl of tadpoles, minnows, a turtle, or frog be placed in the science corner with the question in large print above it: Would this animal live in our desert terrarium?

A live rabbit or squirrel in an animal cage would also be helpful with the question: Would this animal live in our aquarium? Would it live in the cage?

Developing the Concept Field Trips: As a result of questions and comments stimulated by the tadpoles or the turtle and by the animal in the cage, the class would be taken on the second field trip (first was for plant observation) to the same location, this time to observe animal life in different communities. Most animals observed in the woods can be identified (squirrel, rabbit, birds, lizard, beetles, insects, spiders). Teacher should list animals. Allow children to collect insects, minnows, frog, turtle, or any animals found in or near water that can be observed for a time in the classroom. Hopefully, some water birds will be observed. List animals seen on, in, or near water, that had not been seen in the woods. Any insects, frogs, minnows, snakes, etc., taken on the field trip should be properly cared for on the return to the classroom.

Extending the Concept

1 Place the lizard, toad, or other small land animal in the terrarium.
2 Place the minnows, snails, tadpoles or other water animals in the aquarium.
3 All this time, point out that the kinds of animals noted in different locations were determined, to a large extent, by the environment.
4 Point out that food for animals living in the woods and fields would be different from food for animals living in the water.
5 Horned toads can be obtained from pet shops for a nominal price and will do well in the desert terrarium.

Children will be able to bring pictures of animals who live together in communities. The background for a frieze may be painted with tempera paint or crayons. The plant communities can be painted (trees, shrubs, grass, water, etc.), pictures of animals cut out and pasted in proper settings, or animals may be drawn on the frieze.

Fixing the Concept

Ask:

1 Why do animals found in one location differ from those found in another?
2 What happens if habitat is changed or destroyed by man?
3 What can you do to help provide a suitable environment for animals?
4 What can your state do to provide environments for the animals?

Wildlife Conservation

Concept Wildlife must be conserved and controlled, to prevent extinction or overpopulation.

Purpose of Lesson To help children become aware of animals which have become extinct, those in danger of extinction, and the need for wildlife protection.

Introducing the Concept Arrange a bulletin board displaying pictures of animals which are extinct or scarce. Caption above the board: HAVE YOU EVER SEEN THESE ANIMALS? Where? Why?

Have you ever been to an auction sale and heard the auctioneer crying, "Going, going, gone?" When the last word "gone" has been said, it means the article being auctioned is no longer available to the public. The cry "Going, going, gone" can apply to some of the wildlife in our country at this time.

1 Which animals are "gone?" (Research needed.)
2 Which animals are "going?" (Ask for volunteers to find out which animals are scarce.)

Developing the Concept Early settlers in this country found wild game an unlimited resource and in some cases a pest. Explain this. What are some of the causes of the radical changes in wildlife populations in a matter of a few centuries? (Tremendous increase in population, intensive farming, heavy industrialization.) These factors have led to the unintentional extinction of some forms of wildlife. What animals might still be present in the United States today if man had earlier become aware of the need for wildlife?

Invite a representative from the State Wildlife Commission or U. S. Fish and Wildlife Service to consult with the group on local game laws, and the responsibility of the departments concerning management and enforcing the laws, etc.

The work of the game warden would also be of interest to the boys. Who makes the game laws? How is the decision made as to what laws are needed? (Research and study is made concerning the status of game in the particular state.)

Game laws vary in different states.

At one time, all hawks and owls were considered enemies to the forest and the farmer. They have been found to be effective in the control of mice and rats and are now protected by law in some states.

1 Why is it necessary to change game laws from time to time? (Understandings change, research finds population changes as a result of laws made and enforced.)
2 Why are there now laws concerning the hunting of some animals?

Extending the Concept Research shows that bluebirds are scarce in some areas. Why? (They prefer hollow trees or nesting boxes). What can we do to attract and provide for the bluebirds?

Project: Build bluebird houses (consult specifications) and locate them in suitable places at school, camp, or home. Bluebirds will not nest in heavily populated areas. Have children find out about game laws. Explain hunting season laws, laws concerning limits, etc.

1 If you see a hunter kill a squirrel out of season, or catch over the limit of fish, what should you do?
2 Who owns the birds, animals, and fish of our state?
3 What special rights (if any) has the owner of the land on which animals are found?
4 Respect for and compliance with the law is everyone's responsibility.
5 Draw a cartoon showing a good sportsman—or a bad sportsman.

Suggestions:

1 Visit the legislature, if possible, when game laws are being discussed or acted upon.
2 Use films suggested in *Instructional Materials.*
3 Have reports on or skits about famous conservationists. (Gifford Pinchot, Theodore Roosevelt, John Muir, Aldo Leopold.)
4 Write to the State or National Wildlife Service for aids and information on wildlife.

Fixing the Concept

1 How does game management contribute to the balance of nature?
2 What is your responsibility in the conservation of wildlife?

IDAHO DEER

There are two kinds of deer in Idaho--the mule deer (Odocoileus hemionus), which s most common, and the whitetailed deer (Odocoileus virginianus), found mostly north f the main Salmon River. However, there are a few in some other parts of the state.

The whitetailed buck has antlers which branch up from one main horizontal beam, hich curves forward on each side. They are easily distinguishable from the antlers f the mule deer, which grow directly upward in a series of Y-shaped branches.

The tail of the whitetailed deer is long, wide and flat. It is brown with a hite border around the sides. The underside of the tail is white and when the deer s frightened or startled, the tail becomes erect, exposing the white part. The onspicuous waving of the tail, reported by many as a "flag" is characteristic of his species when alarmed and makes the whitetail easy to identify.

Whitetailed deer usually range at lower altitudes than mule deer. They are enerally found in valleys and river bottoms, often near agricultural districts. Both ule deer and whitetailed deer are principally browsers. That is, their main diet is he twigs and other tender parts of woody plants. In addition, they eat rough forage f many other kinds, including weeds, but they take little grass, except in the early pring when other foods are scarce. Whitetailed deer in Idaho browse chiefly on red- tem ceanothus, willow, mountain maple, redosier dogwood and serviceberry shrubs.

The mule deer is the common species south of the main Salmon River, and there re quite a few in some parts of North Idaho. The mule deer has large mule-like ears nd a round black-tipped tail that is shorter than that of the whitetailed deer. The ule deer does not raise its tail when startled, as does the whitetail. Idaho mule eer are generally larger than Idaho whitetailed deer.

Most Idaho mule deer inhabit the higher mountain areas and usually stay up high ntil driven down by snowstorms in the fall. Mule deer are also abundant in a few ough semi-desert areas of the state. They browse mostly on bitterbrush, mountain ahogany, redosier dogwood, mountain maple and serviceberry shrubs.

The bucks of both species shed their antlers every winter. New antlers begin to row in early spring and have attained their full growth by mid-summer. They are soft nd very sensitive during the growing stage and are covered with a fine fuzz that is ommonly called "velvet." In late summer, the antlers harden and the "velvet" shreds way, leaving the bone-like antler with which most people are familiar.

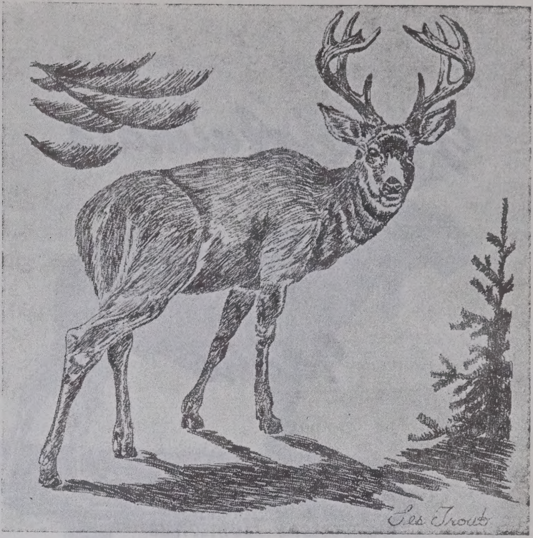
Mating season for both species begins in late October but reaches a peak in late ovember and early December. The fawns are usually born in late May and June and each maturity during their second year. Twins are quite common with both whitetails nd mule deer. Deer herds on good range increase rapidly. The yearly increase is sually considered to be around 25 percent, but it is sometimes greater. A herd ould more than double its number in four years. Sometimes deer increase so rapidly hat they overcrowd their range and there is not enough food to support them all. ame managers often see a greater threat in underharvest of herds than in overharvest.

Many of the original valley wintering areas are now used by man and are no longer vailable to deer. Hence, the animals often have to winter in places which do not ave much natural feed, and a food shortage may result. For this reason, hunting easons are planned to allow removal of enough deer so there will be sufficient food n the winter range to carry the remaining animals safely through the winter.

Game Animals of Idaho

THE WHITETAILED DEER

(*Odocoileus virginianus*)



Description: The whitetailed deer is a graceful nal, at maturity ranging in weight from 100 to 350 nds or more, with a length of five to six feet, and ding 30 to 40 inches high at the shoulder. In its k, reddish summer coat, marked with white about eye, across the nose, throat, and underparts, this r is one of the most striking of our wildlife forms. The bushy tail is carried aloft in flight, to reveal the te undersurface, a "flag" that never fails to catch eye. In winter, the coat is grayer and heavier. The tetailed deer is somewhat smaller than the mule r, and is somewhat more trim, or "racy," in general d and appearance.

Antlers of the buck are characterized by tines branch- upward from a forward-curving main beam, and are ceably different from the Y-fork pattern of the mule r antler.

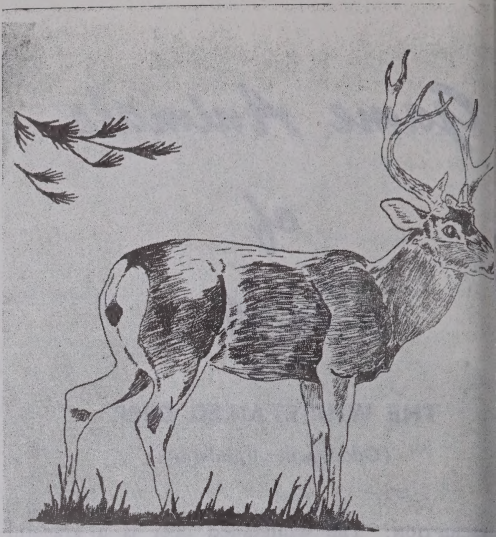
Distribution: Most of Idaho's whitetailed deer are nd north of the main Salmon River. Southern limit ts range here is about the latitude of Warm Lake, Valley County. Some whitetails have been trans- nted from Kootenai County into Boise County along Payette River, and the Teton drainage, in recent rs, and it is possible that the animal may become stablished in these sections. It prefers the heavy er of a humid habitat, and generally ranges lower do the mule deer. It is typically a deer of deciduous dlands and dense coniferous growth rather than more open, semi-arid country, and apparently thrives l in close proximity to man, where cover provides ealment.

Food and Habit: Food of the whitetail consists ely of browse, the tender twigs and leaves of woody ts, trees, and shrubs. In addition, it eats some grasses, weedy plants, and other vegetation produced on the slopes and river bottoms. During the year it feeds on most of the palatable plants found in its range. Food studies show the diet varies widely with the type of plants encountered. Bitterbrush, mountain mahogany, mountain maple, redosier dogwood and service berry are favorite foods. Leaves of cedar and fir are relished on the winter range. Mineral licks are visited and used chiefly in the spring of the year when salt needs are high, due to the scarcity of this mineral in new plant growth.

In Idaho the whitetail mates in October and November. The fawns, of a reddish color, spotted with white, are born in late May or June, and weigh four or five pounds at birth. During the first few weeks of life, the fawns spend most of their time in concealment, visited periodically by the mother, which feeds nearby. Danger from predators is high during this period, but within a month the fawns are able to travel with their mothers.

Enemies of the whitetailed deer include the cougar, coyote and lynx. Sometimes stray dogs have been known to develop bad habits of running deer during the season of deep snows. At this season, when weakened by prolonged effects of winter, the deer sometimes suffer from attacks of coyotes in packs. Effects of disease also may be seen in deer past their prime when weather and poor range combine to weaken wintering deer. However, whitetailed deer are very prolific, and a herd on fair to good range may increase its numbers by twenty-five per cent or more in a normal year. Chief limiting factor on Idaho deer numbers is the overcrowded winter range. Artificial feeding has not proved to be the remedy when range deficiencies develop. In Idaho the practice of permitting the kill of both sexes does much to aid the proper harvest of suitable deer numbers.

Game Animals
of
Idaho



THE MULE DEER

Odocoileus Hemionus

Description: Several subspecies of mule deer are listed for the western states with the Rocky Mountain mule deer considered the largest with an average weight of 150 to 200 pounds. They are from three to three and one-half feet high at the shoulder when mature. Some big bucks will weigh up to 400 pounds. This mule deer is the most abundant big game animal in Idaho.

A stout-bodied animal, this deer has a gray coat in winter, changing to reddish-brown in summer. It has a short tail which has white hair and a well-defined black tip. The ears are large. The forehead has a dark brown patch and the rump on both sides of the tail is white.

Mule deer antlers, unlike those of the whitetail, are double forked; that is, each of the two main beams has a fork in normal growth. Four points on each side is typical on mature bucks, but five to seven points on one side are not uncommon, and the number may exceed ten. A few record Idaho heads had a spread exceeding 35 inches with 20 to 30 points.

The mule deer has sometimes been erroneously called a "blacktail" but there are certain striking differences in color. The entire upper surface of the Columbian blacktail is black—the mule deer tail is white with a black tip. There are no authentic records of blacktail deer having been taken in Idaho.

Distribution: Mule deer range over the entire state, although in larger numbers in the rough, open mountain regions of the southern half of the state. It is found in the high ranges as well as the semi-desert areas. This deer is not as partial to heavy timber, or dense brush areas, as the whitetail deer.

Food and Habits: Mule deer have been called "jumping deer" because of their high, bounding gait which enables them to survey surrounding terrain while in flight
frightened, mature mule deer may clear more thar
feet at a bound on a downhill slope. They have b
reported to attain a speed of 35 miles per hour. B
deer ordinarily shed their antlers in January and Fel
ary—a few even later in the spring. New growth st
soon after with the antlers fully grown by mid-Aug

Most fawns are born in June. Many twins are
and triplets have been observed. Under poor ra
conditions the doe may have only one fawn. The yo
have spotted coats, seemingly for camouflage, as
crouch low to the ground and blend into the surrou
ings when danger threatens. In a few weeks the fa
are nibbling tender, green forage, and generally
weaned from their mother by the end of Septembe

Mule deer feed on a variety of browse plants. Bi
brush is a preferred food along with twigs and leave
aspen, willow, serviceberry, elderberry, mour
mahogany, redosier dogwood, sagebrush, mour
maple, and a variety of smaller annual and perer
shrubs, weeds and grasses.

Mule deer often spend the winter up along ro
windswept ridges if browse is available. Usually,
snows force most of the animals to lower ranges.
does usually spend late spring months at low elevat
—making their way to the high areas when the fa
are able to accompany them.

Enemies of the mule deer include the cougar,
bear, and the coyote. Of course, the cougar is per
the most effective. Predators have little effect upon
populations, although some toll is taken of weake
unfit or easily captured animals.

The primary cause of deer loss is failure of the r
where wintering herds have overused the main plan
which the animals depend season after season. Pr
hunting each year helps this condition by remo
surplus animals and giving food plants a chance to
future growth. Both the deer and the range plant
in good condition in properly managed areas.

Game Animals of Idaho

THE MOOSE

(*Alces americana*)

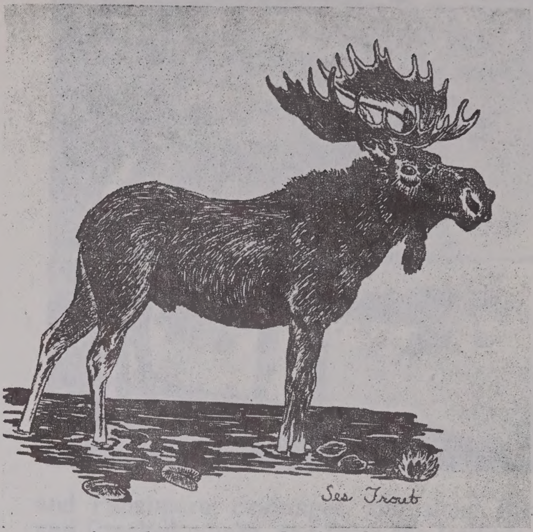
IPTION: The moose in Idaho is said to newhat smaller than those found on parts of the North American continent, referred to as the Yellowstone Moose, or yoming Moose.

largest member of the deer family, the is an ungainly, long-legged animal with d shoulders, long, heavy head, broad, lous muzzle, and large ears. The color kish-brown on back and sides, lighter s and underparts. Antlers of the bulls eavy and palmated. From the throat sexes hangs a growth of skin and hair the "bell." The hoofs are long and d.

rge bull might measure ten feet from nose to tip of tail, with a shoulder height re than seven feet. The animal stands ably higher at the shoulder than at the Weights of up to 1,800 pounds have ecorded for Alaska moose, but few Idaho have been taken above 1,400 pounds, ne average well below that figure. Cows out three-fourths the size of the bulls.

BUTION: In Idaho today moose are scat- paringly along the mountainous eastern of the state from about the latitude of Springs to Lake Pend Oreille. Most of are in the Targhee National Forest of Idaho, with a few hundred more dis- ed in the uplands of the Clearwater, rce and Bitterroot forests farther north.

AND HABITS: During the summers the is partial to wet uplands where swamps atercourses afford opportunity for the s to submerge to escape the flies and to the succulent aquatic and marginal for- ch as lily pads, grasses, sedges, alder, nd willow it prefers. At other seasons it ange the slopes and ridges where maple,



mountain ash, aspen and other browse species are found. During the winter months it descends to the river bottoms and flats to escape deep snows. In Fremont County it has been observed on winter range miles from heavy timber country.

Calves are born in late May or June, and follow the mother closely during their first year. Unlike other deer they are unspotted at birth. Twin calves are infrequent. During the mating season the bulls may be dangerous to man. In one instance a game department officer afloat on a raft on an Idaho County lake was approached by a swimming bull moose that exhibited a great show of belligerence. The water was deep and the animal rolled under the surface a few feet from the raft and came up snorting and thrashing the water with its front feet. The bull did not actually attack the raft, however, and in a few moments returned to the lake shore and made off in the underbrush.

HARVEST STATUS: In early times heavy hunting almost obliterated moose in Idaho. One of the first acts of the state game department was to close the season on this animal. Since then the moose has been on the increase, spreading from the areas closely adjacent to the Yellowstone Park into Idaho's eastern counties, and northward along the Idaho-Montana border.

In 1946 the first of the annual series of special hunts was conducted.

Game Animals of Idaho

THE ANTELOPE

(*Antilocapra americana*)

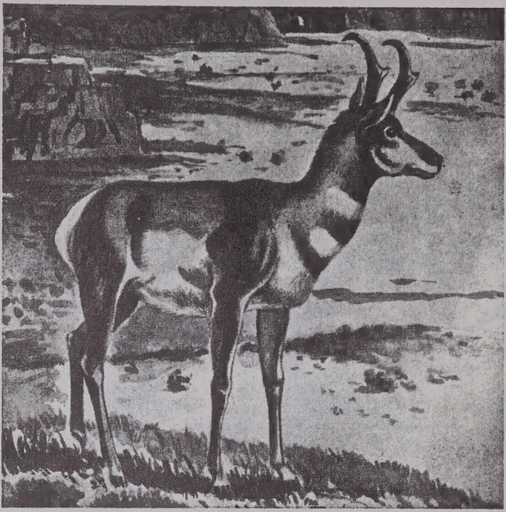
SCRIPTION: The pronghorn antelope is one the most interesting mammals in Idaho. sessing many unusual characters not found ur other hoofed game. A graceful animal, ewhat smaller than deer, the pronghorn plays a nervous, restless temperament and king appearance.

olor of the pronghorn is brownish-tan ve, darker along the neck and mane, and h contrasting lighter underparts, neck bars rump. A dark patch below the ear dis- guishes the buck. Pronghorns are the most tfooted of American mammals, the long der legs capable of speeds up to sixty miles hour.

orns of the bucks average ten to twelve hes in length—trophy heads are bigger— h sharp, curved tip, and a single fork or ng jutting forward about midway on the m, which gives the pronghorn its name. rns of the does are smaller, or wanting. The nghorn antelope is the only animal in the rld that sheds the horn annually. This horny ath is dropped in late fall or winter to re- l a bony horn core on which is produced the horn material. Unlike other hoofed game mals the pronghorn has only two toes on h foot; the dewclaws have disappeared. Un- deer the pronghorn possesses a gall dder.

STRIBUTION: The pronghorn antelope is nd only on the North American continent. rmerly abundant, today it is distributed in ert portions of fourteen western states, stern Canada, Lower California and north- Mexico, in greatly reduced numbers. Total Idaho is approximately 15,000 head.

Most of these are found on the headwaters the Big and Little Lost rivers, the Lemhi and Pahsimeroi drainages, and along Birch and Crooked creeks, and from the latitude of Arco and Mud Lake in Butte and Jefferson counties north to Salmon.



Livetrapping and transplanting operations during the past decade have resulted in creation of other small bands of antelope in the Snake river plains area both north and south of the Lake Walcott section. A population of pronghorns also exists in the Owyhee county desert of southwestern Idaho.

FOOD AND HABITS: The pronghorn antelope thrives in desert habitat, seemingly able to extract moisture for its bodily needs from the weeds and grasses on which it feeds during dry periods to augment its water intake. The diet also includes sagebrush, bitterbrush and other desert shrubs. It offers little or no competition to livestock which finds many of these desert weeds and shrubs unpalatable. It does relish alfalfa, however, and sometimes may damage hay crops where it ranges adjacent to irrigated ranches.

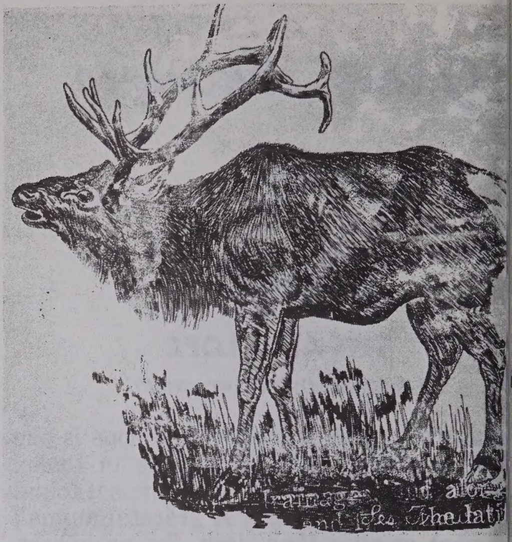
The fawns are born in May in Idaho. Twins commonly occur where habitat conditions are suitable, but triplets are rare. The mother pronghorn seeks the open high desert at this time where she may easily observe the countryside for the approach of predatory enemies.

HARVEST STATUS: Average annual take of antelope by Idaho hunters since 1943 is 966 animals, with the peak harvest figure of 1,520 pronghorns recorded during the hunt of 1952.

Game Animals of Idaho

THE ELK

(Cervus canadensis)



Description: The Rocky Mountain Elk is a large, stately deer. The body is gracefully proportioned, bulls standing five feet at the shoulder, and weighing up to 800 pounds or more, with an average weight of about 600 pounds. Cows are smaller. Many hunters consider the elk the finest game animal in America.

The color is a tawny or yellowish grey, with chestnut head and neck, shaggy mane, dark legs and blackish underparts. The rump patch and tail is a conspicuous straw-color. The winter coat is lighter, particularly in bulls. American elk are related to the European Red Deer. The name "elk" was given to our species by early settlers from Europe, and the Shawnee Indian name for the species, "wapiti," also is in common use.

Distribution: Today Idaho elk herds are found in most of the national forest lands from Boundary county to the southern border of the state. Largest concentrations are in relatively inaccessible uplands of central Idaho which make up the Clearwater drainage and the Chamberlain basin area of the Salmon river watershed. Good numbers now are found in the Boise and Payette river drainages and in rugged parts of eastern Idaho.

In early times the elk probably roamed over most of the area now included in the state, although it is unlikely elk were as abundant as they are today. Game department records for the 1920's show an annual harvest of fewer than 500 animals annually, and the harvest in the 1930's was under 2,000 head annually.

Effects of the 1910 and 1924 "big burns" on regrowth of browse plants in the Lochsa and Selway areas were reflected in soaring elk populations and by the middle 1940's the annual elk harvest passed the 5,000 mark. Even so, gun pressure did not keep up with herd increments. In the 1930's and 1940's sportsmen in many parts of the state cooperated with the department in securing elk for transplant from points in Wyoming and the Yellowstone Park area. One of the early releases was made by Boise sportsmen above Arrowrock da
and in 1916 another plant was made on the Pocate
game preserve. Additional releases were made at poi
in the Idaho Panhandle, and in Owyhee county. All th
releases influenced elk numbers in the local areas.

Food and Habits: Generally spending their summers
the uplands, elk in fall move down into lower ele
tions for the winter period. Although possessing excell
sight and hearing, the wapiti depends very heavily o
highly developed sense of smell, as hunters will att
The brown, whitespotted calves, born in the upla
in May and early June, depend entirely on their moth
milk for the first four to six weeks of life, but gr
rapidly and are browsing with their parents by m
July. Idaho studies show elk mothers produce abou
75% calf crop. Coyotes, cougars and bears may ta
some calves. Most serious losses suffered by elk, ho
ever, other than the annual gun harvest, is the win
kill, which may be severe in bad years. Winter loss
aggravated by depletion of the range in wintering ar
where large numbers of elk congregate year after year

Elk depend almost exclusively on browse plants
winter, but are observed to take grass and other pl
food in summer seasons. Because they can utilize coa
browse, and reach higher in their feeding than deer,
soon dominate a given range and tend to exclude
deer when they move into a region.

Bulls sprout new antlers in April and shed the vel
covering the antlers in late August. In mature anim
the antler may have six to eight points, including
impressive, forward thrusting "brow tine."

During the mating season bulls try to group co
into "harems" and sometimes fierce battles develop
tween the males. Bugling becomes prevalent in
August with the approach of the mating season,
reaches its peak in September when the wild, inspi
challenge of the bull elk is a common sound in muc
Idaho's big game country.

Game Animals of Idaho

THE MOUNTAIN GOAT

(Oreamnos americanus)

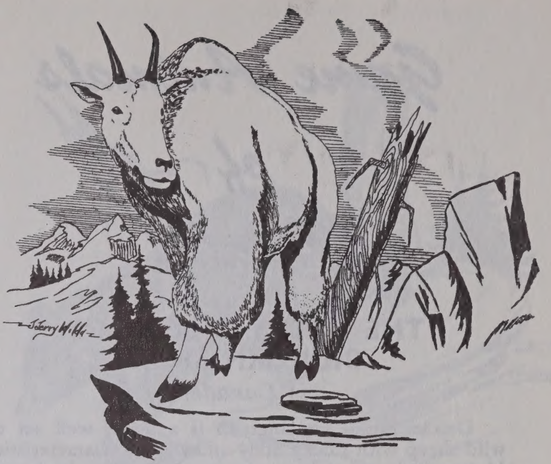
ESCRIPTION: The mountain goat is a hump-shoulder- hort legged animal, bearded and goat-like in ap- nce, with sharp, backward curved horns. It is not e goat, but is related to the European chamois and species of the antelope families. The all white is thick and shaggy. The guard hairs grow very about the shoulders and upper legs. The underfur ense, high quality wool. In early days some Ameri- ndians used this wool to weave blankets and gar- s. The mountain goat is the only native North ican animal that produces wool.

oth the males and females have horns. Horns of nales average eight or nine inches long--those of emales are shorter. Horns and hoofs are black. The have a hard outer shell. The basal pads are not ed, but are convex, rounded and flexible to provide lent traction on rock surfaces.

ature mountain goats rarely exceed 150 to 200 ds in weight. They are about five feet in length— three feet tall at the shoulder. The females are er than the males.

ISTRIBUTION: Mountain goats inhabit rugged and sections of Idaho's interior mountains. The south- mit of goat range is in the Big Wood and Big Lost drainages, and in some parts of the Boise and Pay- River watersheds. Approximately 750 goats inhabit areas. Farther north, in the Salmon, Clearwater, ay and Lochsa drainages, nearly 2,000 more head are . Additional small herds totaling about 250 head in extreme north Idaho, in the Selkirk and Cabinet tain ranges.

rior to 1948 mountain goats were legally hunted g regular hunt seasons. The season was closed in 1949, and re-opened in 1950 on a special hunt There was no season in 1951, but a limited annual as been permitted since that year. Present manage- regulates the take by removing only a few animals each of the management units.



Food and Habits: Much of the goat range is in a semi-arid region. Goats prefer grasses like bluebunch wheatgrass, Idaho fescue and others, in addition to shrubs like willow, chokecherry, mountain mahogany and ceanothus.

Food studies indicate mountain mahogany ranks high on the preferred list, with balsamroot an important food item. During deep snow periods goats have been observed feeding on conifer needles where trees are along the ridges. Goats winter at higher elevations than our other big game animals.

Mating takes place in late November and early December. The kids are born in May and June. The mother goat usually leaves the herd a short time before the arrival of her offspring. When the young goat is able to run about, usually a few days after birth, the mother rejoins the herd. The old males generally live away from the main herd at this time of the season.

The kids learn to forage when just a few days old, and may be weaned at eight to ten weeks of age. They remain with their mothers during the first year of life. The youngsters are active and full of play. The normal gait of the adult goat is rather slow and deliberate.

Field studies of the mountain goat in Idaho has shown a heavy loss in numbers of young animals during the first two years of life. This may be due to adverse wintering conditions with diet deficiencies. There is some evidence that parasites, both internal and external, take a toll when malnutrition weakens the animals.

Mountain goats are known to be preyed upon to some extent by cougars. The golden and bald eagles have been observed carrying off a young kid, but such acts are extremely rare. Coyotes and bobcats have been observed stalking goats at times, but known instances of actual kills are also rare.

Game Animals of Idaho

THE ROCKY MOUNTAIN BIGHORN SHEEP

Ovis Canadensis

Description: The bighorn is a large, well set up wild sheep with stocky body and rugged characteristics. Mature males carry heavy horns which curve backward, outward and downward to form a complete curl beside the head.

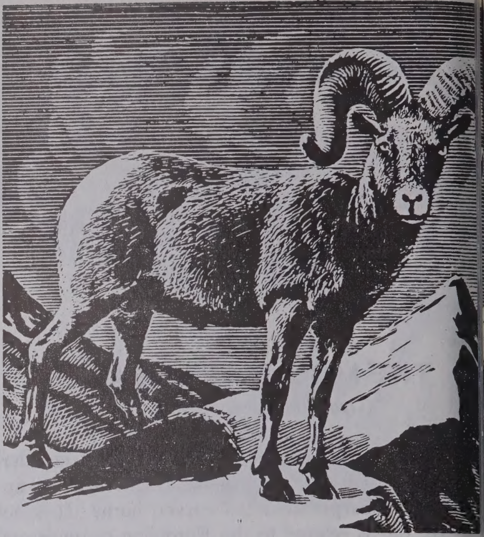
Females and young males have smaller horns, only slightly curved. The horns are rough, ringed with noticeable transverse ridges. Unlike the bony antlers of deer, these horns are not shed, and continue to grow during most of the animal's life. In older rams the curl often exceeds a full circle and is heavy and massive. The hoofs of bighorn sheep have a concave bottom and sharp edge, enabling the animal to hold well on slippery or steep sloping rocks.

The color of the mountain sheep is a brownish gray, darker along the back and on the legs. The rump patch is light in color, matching the light underparts. The outer hair is course, with a finer undercoat. However, this sheep does not have a woolly coat like the domestic sheep; its coat is distinctly hair-like.

Male bighorns average 175 to 200 pounds, with some big rams reaching a larger size. Trophy rams may exceed five feet in length from nose to tail. The ewes are smaller.

Distribution: It is estimated that the number of mountain sheep in Idaho in 1955 is in the neighborhood of 2,500 head. Most of these are confined to the Salmon river watershed in the rugged interior of the state, in Custer, Idaho, Lemhi and Valley counties. Department biologists estimate that about one-half of the total number are distributed along a stretch of the main Salmon river and the Middle Fork about sixty miles in length, with most of the remainder occurring in similar habitat along the East and South forks and along the main Salmon river and its tributaries. Department studies show that sheep in summer range principally from 6,000 to 11,000 feet elevation, descending in the winter season to suitable wintering habitat of 6,000 feet in the upper parts of the drainage, down to as low as 2,000 feet along the main Salmon river. These studies further show that while the original Idaho bighorn sheep range included areas underlain by sedimentary rock, such as the Lemhi and Lost river ranges, sheep occupying our high ranges today are almost entirely confined to mountains of igneous formation.

Food and Habits: Sedimentary rocks generally produce more fertile soils than do those of granitic origin, which may explain in part dietary deficiencies limiting our Idaho bighorn herds. It may be that sheep in those



earlier times enjoyed a more balanced diet tha available today.

Food studies reveal that the Salmon river big depends on browse plants like the mountain maho sagebrush and other shrubs for approximately one-fo of its annual subsistence, with grass and other gras plants, weeds, etc., providing the bulk of its diet. T same studies reveal that in some seasons when and weeds are abundant, the sheep will take more 85% of this type food. Even in winter, sheep wi down through the snow to secure grass and herbac plants, utilizing more of this type food than of bro Like other big game animals sheep seek mineral dep or licks at all seasons, particularly in spring. The w range generally includes considerable south-fa slopes where the snow is light.

Peak of the rut in the Salmon river range is rea in late November and early December. At this tim rams fight furious battles with one another, back forth across the rocky slopes. The sound of the cras shock of collision when the massive horns come tog can be heard long distances in the still air. Most o lambs are born in late May, usually on a warm exposure where rocky outcrops abound. Twin l are exceedingly rare among this species. The y sheep grow rapidly. They are extremely active anc of play, and their voice resembles that of dom lambs.

It has not been established that predators ar important limiting factor on our wild sheep. Co and coyotes both have been observed stalking fe bands of ewes and lambs on the summer range, b practically all cases the attempts of the predators unsuccessful. The golden eagle also has been bl for losses to the lambs, but close observations of birds on the summer range has not revealed their p tion on lambs as a significant factor. What part di and parasites play in the present populations i known. It may someday be recognized that the bination of dietary deficiencies, restriction of h and local conditions all play a part in reducin vitality of this game animal to the point where di takes a critical toll.

Game Animals of Idaho

THE BLACK BEAR

(Euarctos americanus)

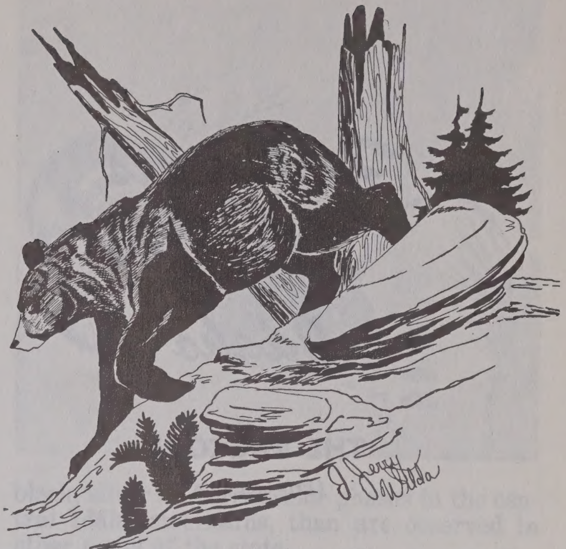
ESCRIPTION: A black, rusty or cinnamon brown bear dium size, measuring about six feet in length, three in height at shoulder and averaging 250 to 300 ds at maturity. Some big males have weighed more 500 pounds.

he black bear has a pointed face, straight in pro- vith heavy body and flatfooted shuffling gait. The shaggy, long and soft. This bear is able to stand when it needs a better view, and can move with ising speed when the occasion demands. Ears and re short, and the claws are well curved, enabling nimal to climb trees readily.

ISTRIBUTION: Elusive by nature, the black bear in prefers remote, timbered, rugged, mountainous of northern, central and eastern Idaho. Bear hunt- s increasing in popularity. Recent minimum esti- s placed the annual kill near 400 or 500, and the hunters' questionnaire indicated a kill of over 2,000. season on black bear is limited to the months of mber, October and November in the five northern ies of the Idaho Panhandle; in the remainder of tate bears may be killed at any time of the year. ever, only one bear per person is permitted during eason. There is no open season on grizzly bear in , although a few grizzlies are observed along the -Montana boundary and in the area adjacent to wstone Park.

OOD AND HABITS: Black bears will eat almost any- edible, plant or animal, which they encounter in foraging. Fruit, stems, leaves, roots and bulbs are med, along with insects, rodents and other mam- nestlings, eggs, flesh or winter-killed deer or elk, y animal they might catch and kill while ranging gh the woods. Dressed deer and elk left out over- in big game country sometimes are discovered and ged by bears.

ears are not sharp-sighted, but possess a keen sense ell on which they depend heavily when hunting or in the avoidance of danger. Black bears spend time along streams but are not as adept at fishing e their larger cousins, the grizzlies and the big n bears of the coastal areas.



Occasionally a black bear will develop a taste for sheep and calves where summering bands and herds of livestock are brought into its range. Extensive damage to these has been reported in some instances before the offender was destroyed. It is also assumed that some deer and elk fawns and calves are caught and killed in summer also. However, the bear is not considered an important predator on game.

Black bears usually mate in June. Mother bears produce cubs every two years. The cubs are born in January while the female is in hiberation. These young are blind, hairless and toothless, weighing only six to eight ounces at birth. With the arrival of spring these winter-born cubs may weigh three or four pounds each and emerge to the world outside the den hungry and active. The brood may consist of from one to four cubs, but twins are the most common number. These are either brown or black, and grow rapidly.

Cub bears quickly learn to seek safety among the limbs of the protecting trees when danger threatens, and are taught by their mother to remain aloft until she feels danger is past. Young bears are among the most playful of wild creatures, and spend much time romping and wrestling with their mother and each other. Unless accident separates mother and cubs they remain together through the summer and fall, and frequently go into hibernation together when November snows make them drowsy and send them in search of a winter den. At this time they are very fat and need no food during the winter's sleep.

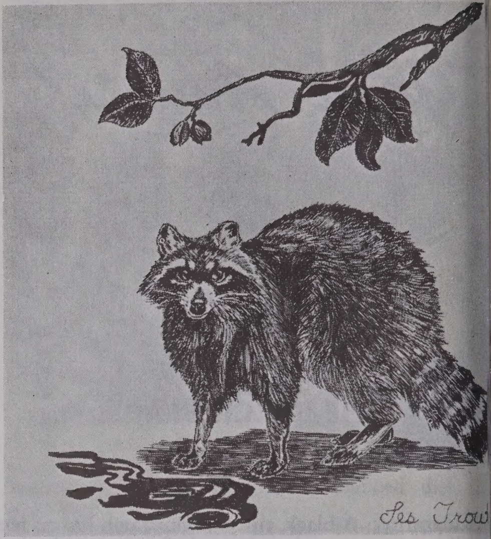
If the winter is unusually mild a bear may leave its den as early as February, although it may remain out of sight until April if spring is tardy and snows are deep. Cubs past two years of age gradually break family ties as the June mating season approaches for the mature bears, and the young bears are then on their own.

Bears have few enemies with the exception of man, for only a very bold or desperate cougar would attack a black bear.

Furbearers of Idaho

THE RACCOON

(*Procyon lotor*)



Description: The raccoon is a heavy-bodied, furry animal with pointed, alert face, large, erect ears, and banded, bushy tail. The face is dark, masked across cheeks and eyes with a black band. General body color is greyish.

The feet are large and the raccoon walks with an ambling gait, the hindquarters carried somewhat higher than the front of the body, with the heel of the hind foot resting on the ground in the manner of its big cousins, the bears. The front feet are supple and hand-like, adept at holding food or for use in climbing. The black mask and banded tail are good field marks.

Raccoons stand only about a foot in height, but may measure three feet in length. The weight of an average specimen is about fifteen pounds, although an exceptionally fat individual may weigh as much as 25 pounds.

Distribution: While not common in the state, the raccoon is found on most of the major watersheds. It seems to be increasing in recent years. Trappers report them in many sections, at various elevations, from the lower Clearwater to the upper tributories of the Snake river in Southern and Eastern Idaho, in Owyhee county, on the Boise, Salmon, and Payette river drainages, and in agricultural sections. It is most numerous along the lower river valleys.

Food and Habits: The raccoon ranges where food is most abundant not too far from watercourses providing suitable brushy and rocky cover. Although denied the comfort of hollow "den trees" in most of its Idaho range, it utilizes streamside tangles, brush piles, burrows, rocky crevices and other suitable hiding places. Coons are nocturnal in their habits, and their tracks in the mud of streams, canals and reservoirs reveal their wandering forages.

Preferred food is any small aquatic or semi-aquatic form that can be caught in shallow water or in the adjacent marginal litter or vegetation. Frogs, minnows, crayfish, angleworms and insects are eaten; birds, nestlings, and eggs are taken on occasion, and any unwary rodent that may be cornered and caught in the dusk or darkness is included. Like the bears the raccoon also relishes vegetable foods, and will hunt for fruits, be
grains, and other plant parts to balance its diet.
other carnivores that dwell near man, the coon s
times develops a taste for domestic poultry, and mu
trappers have complained of raids on the trap line
individual raccoons. In Idaho there are few, if
records of such occurrences, due to relative scarcit
these creatures in our marshes. The coon has been t
in traps at the department game farms where they
apparently been attracted by the presence of large
bers of the birds.

Raccoons are polygamous but family groups somet
include the males, indicating some family ties are fe
both adults. The mating season is in February, wit
young born in late April. Three to six young const
a litter. These begin to accompany the mothe
feeding excursions in mid-June, usually starting
nightly jaunts at the onset of darkness.

It has been said that the raccoon's habit of "was
its food before eating is not due to a desire for cle
ness, but is necessitated by a saliva deficiency. At
rate, the coon often moistens its food in the nearest
before devouring it.

Raccoons will fight viciously in self defense, or i
fense of the young. Only a very strong and courag
dog will vanquish this husky carnivore. The coon
to water readily to escape its enemies, and can swim
When cornered or angry the raccoon growls fie
At other times family groups communicate in soft,
ring undertones, it is said. Another call, heard at n
might be mistaken for the drawn out tremolo o
screech owl, naturalists report.

Cold spells cause raccoons to curl up and slee
the dens, although body temperatures do not drop
cases of true hibernation. A rise in weather tempera
during the winter months will bring them out to re
activities in search of food.

In some states the coon provides some sport for
who enjoy hunting with dogs, but in Idaho the ani
choice of rocky den sites renders it safe from this ty
hunting, and it is unlikely that the raccoon will be
popular here as a sporting animal before the houn

Furbearers of Idaho

THE RED FOX

(Vulpes Fulva)

SCRIPTION: The red fox is a small animal, ut sixteen inches high at the shoulders, and ee to three and one-half feet long at ma- ity. Its weight is seven or eight pounds en fully grown.

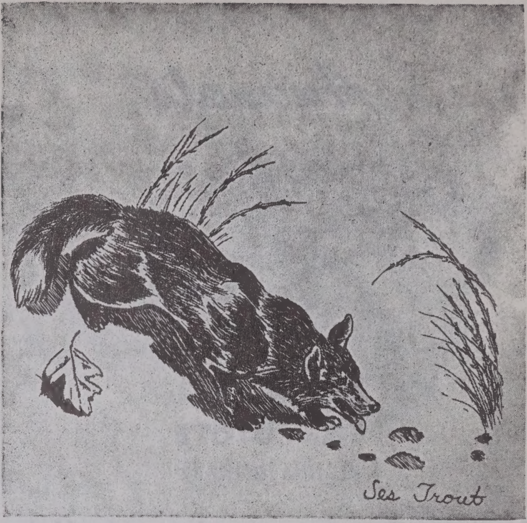
The fur is long and soft, of a golden reddish or above, with white on chest and under- ts. The long bushy tail is white-tipped, n in the black and silver color phases. The alled "cross" fox is another color phase of s species in which a dark band across the ulders intersects a similar dark band down back producing a cross effect. The large ngular ears are black, as are the feet and er legs.

Legs of the red fox are slender, and the small, and the animal moves with airy ce, sometimes with the tail carried above horizontal. It is a noiseless hunter.

STRIBUTION: This species is the only fox rently being taken by Idaho trappers, al- ugh in the past its small cousin, the desert kit fox, was recorded from Owyhee county. e gray fox (Urocyon) does not occur in ho.

The red fox is found in the higher moun- ns of Idaho north of the Snake river plains. hough it is not often seen, it is not uncom- n in this range, preferring to live at eleva- ns from 4,000 feet in the Panhandle to 8,000 t or higher—at timberline and above.

Trappers report them most numerous on headwaters of tributaries of the Boise, yette, Salmon and Clearwater river drain- s, with their range extending eastward to Henry's lake region, the mountains of the rghee forest, and the Caribou mountains. these uplands it makes its home among ky ledges, and in mountain meadow habitat. ese reports indicate there are more of the black, silver and cross color phases in the central Idaho mountains, than are observed in other parts of the state.



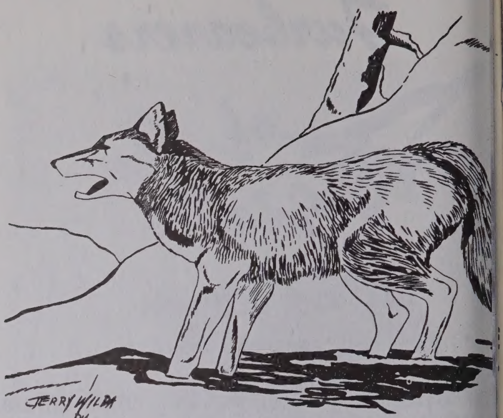
FOOD AND HABITS: The red fox will take whatever small prey is available. It is an excellent mouser and is beneficial in destroying large numbers of rodents annually. It eats grass and other plant parts, fruits and berries, insects, mice, shrews, chipmunks, gophers, squirrels and rabbits in addition to any birds it can catch in its hunting, together with eggs and nestlings of ground-nesting birds.

It has been known to burrow in snow for resting grouse, and rabbits, and to go down through snow to the travelways of mice in the meadows. Bodies of winter-killed animals also may be eaten. Fawns of deer are seldom molested, unless by exceptionally husky male foxes, as smaller animals are generally available during the summer months. It is active in its hunting the year around, by day and by night.

Young foxes are born in late April or May in Idaho. Five or six pups is probably the average sized litter. Foxes are not proficient burrowers, and will occupy dens of badger or coyote, or will use crevices among the rocks for home sites, renovated for use of the new family. Little foxes emerge from the den at about five weeks of age, and soon learn from their parents how to hunt rodents, insects, and other adult food.

ECONOMIC VALUE: Not enough foxes are trapped in Idaho wilds to make the fox an important species in the Idaho fur industry.

Animals of Idaho



THE COYOTE

(Canis latrans)

Description: The coyote is a medium-sized wild dog of slender build with slim legs, narrow muzzle, large, sharp ears and bushy tail. The rather coarse fur is yellowish-gray, touched with black on upper parts and whitish below. Adult coyotes average 3½ feet to four feet in total length, with tail about 15 inches long. The skulking walk adds to the appearance of small size as the animal slinks along with lowered head intent on the sights, sounds and odors involved with food or possible danger.

Distribution: The coyote is known in all the remote corners of the state, from desert wastelands to timbered country. Sometimes it is seen near communities in the heart of settled agricultural areas, because the animal has learned to take care of itself in close proximity to man. In Idaho it prefers semi-arid open range country where abundant rodents provide plenty of natural food.

Habits: Perhaps no native North American mammal has been more persistently hunted and trapped than the coyote, but its wits, resourcefulness and adaptability have enabled it to survive and extend its range. The tawny coat is a blend of desert colors enabling it to escape detection. Its bark from a nearby slope often is the only evidence of its presence as it watches the intruder in its range.

The coyote hunts at all hours. Its food is varied. Anything edible it may find during hunting forays is eaten. Mice, squirrels, rabbits, birds, fish, frogs, carrion, insects, fruit and other forms of vegetation are readily taken in season. At mention of its food habits both friends and foes of the coyote will be heard. These animals have been observed to hunt persistently by the hour for mice, ground squirrels and other small rodents, disregarding birds, game animals, or domestic poultry or stock nearby. On the other hand, coyotes are extremely intelligent, resourceful and clever. When their normal food and carrion are both scarce, they quickly learn to raid poultry runs and sheep ranges, picking off lambs on the fringes of the herd. In late winters they have been known to pull down weakened or half-gro deer hampered by deep snows when other food is sca and hard to find.

The coyote mother locates a den in late winter early spring to house her brood which is born someti in April. The average size of litter is five or six pu although the mother may bear as few as three, and many as 19 (the largest on record). During this ti the male coyote may remain in the general vicinity he is excluded from the home den. Later he may rej the family group. By June the half-grown pups be observed romping about the den area, or stalk mice and insects in grass cover. With autumn the pu are "on their own."

In recent years many cattlemen and sportsmen ha come to the conclusion that the coyote's activities rodent exterminator, sanitary engineer (in cleaning carrion) and health officer (removing sick or we animals) are more beneficial than otherwise.

Sheep ranchers, however, say their losses in lan taken by coyotes call for the severe control measu that are now in effect against the species. Since failure of bounties, which were expensive and ineffectu coyote removal activities have been turned over to p fessional programs. Since 1915, the predator cont branch of the U.S. Fish and Wildlife Service has ported removal of nearly 230,000 coyotes, an avera of 5,500 animals yearly. State trappers also report additional number taken each year.

The coyote is apparently harmless to human life, a domesticated individuals have been known to save lives of children.

Perhaps it should be mentioned that the occasio reports of wolves sighted in Idaho are generally believ to be based on glimpses of unusually large coyotes. wolf skins have been taken in many years, though Idaho Fish and Game department has a record of a lar male wolf taken in the Soda Springs vicinity in spring of 1919. It is, therefore, possible that an oc sional wolf may still be seen in remote areas.

Furbearers of Idaho

THE MUSKRAT

(*Ondatra zibethica*)

cription: An aquatic rodent weighing about two nds at maturity, about twelve inches in head and y measurement, with a ten-inch tail. The name is ved from the musk glands that give the animal its burrows a characteristic odor.

The muskrat's eyes and ears are small and almost cealed in the dense, dark-brown fur. The face underparts are lighter in color. The coat of com- underfur is so dense that water does not penetrate he skin. Innumerable tiny air bubbles enmeshed he underfur add to this waterproofing effect. r the underfur is a coat of longer, black guard s.

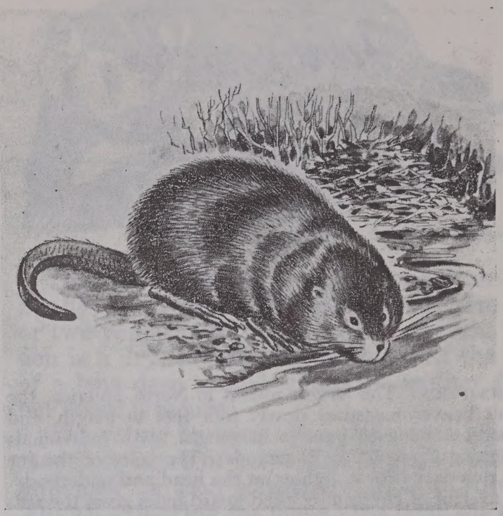
The body is thickset, and the muskrat moves with berate, ambling gait when undisturbed along the e of its native pond or stream. It swims and dives and does most of its traveling in the water. The l feet are much larger than the front feet, with s between the bases of the toes. A fringe of short, hairs along the margins of the hind toes also in swimming. The tail is scaly, almost hairless is flattened laterally, serving as a rudder and scull wimming. The orange-colored chisel teeth reveal muskrat's rodent kinship.

tribution: The muskrat is found throughout Idaho, swamps and marshes, wet meadows, ponds and ams, in the higher drainage areas as well as in the cultural sections of the state. Wherever man-made gation systems are created, the reservoirs and als are soon invaded by the muskrat. It is native to North America.

d and Habits: The muskrat is a vegetarian, but is orted to vary this diet with a taste for mollusks, an occasional frog, minnow or other small aquatic nal form it encounters in its feeding. Its vegetable includes roots, basal stems and leaves of cattail— vorite food--tules, rushes, bark and leaves of tree dlings, grasses and other plants.

Although the muskrat may be observed at any time day, it is most active at night or in the evening rs.

Almost any boy who has followed, with gun or l traps, the still waters of marsh, drainage ditch neandering stream has started at the widening "V" he water ahead as a muskrat pushed its way out of shadows and into the clear light from the reflected . It is one of the moving experiences associated h an outdoor heritage—the dark, bobbing outline head and body, the thin line of tail trailing just ash as the "V" is drawn across the pool, the hump he back as the rat goes under in a swirl of wavelets.



Or the muskrat may be seen quietly feeding on its raft among the stems along the water's edge. If surprised, it goes into the water with a resounding "plunk" to vanish in the plant cover or into the flooded tunnel leading upward to the nest chamber in the nearby bank as the waves of its going subside.

The house or lodge is built during the summer of cut stems of cattail, tule, grasses and weeds cemented with mud, and provided with a lead-in tunnel below the waterline. By freezeup time the occupants are provided with a comfortable nest chamber. A suitable marsh may be dotted with these dark mounds, as well as the smaller feeding platforms among the cattails and rushes. Where the shoreline permits, the muskrats dig inter-connecting tunnels in the banks. Along swiftly flowing streams these burrows take the place of the lodges as homesites.

In Idaho the young are born from late May to the middle of August. Studies indicate six or seven constitute the average litter. Ten or a dozen have been counted, or a mother may give birth to as few as two of the blind, almost hairless kits. Where food and water conditions are very favorable the female may produce three litters during the summer months, the Idaho studies show. Two litters per season is probably a good average in Idaho waters.

Young muskrats open their eyes at about two weeks of age, and at three and one-half weeks are thriving on a vegetable diet and swimming and diving about the homesite.

Studies also indicate muskrats are content to spend their lives in a restricted territory 100 yards or less in extent. Those living along streams are more likely to change their home territories.

Economic Value: Muskrats are our most abundant furbearer, and are most important to the fur trade. The fur, when sheared to remove the guard hairs and dyed black or brown, was formerly known as "Hudson seal." The carcass is sold as "marsh rabbit" in some of the Eastern and Southern states. Value of the pelts varies from a few cents to a dollar or more. In the past few years the annual harvest of Idaho muskrat has approached 200,000 pelts.

Furbearers of Idaho

THE BEAVER

(*Castor canadensis*)

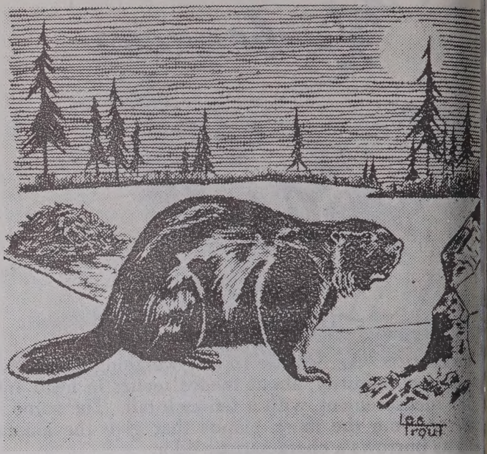
Description: The largest rodent in North America, the adult beaver measures nearly four feet in length, and averages about 40 pounds in weight, with individuals weighing up to 60 or 70 pounds. The color of the fur is a rich dark brown, lighter on the head and underbody. An overfur of chestnut-colored guard hairs gives the animal a shaggy appearance and a golden sheen when the fur is dry. The eyes and ears are relatively small and nearly hidden in the fur.

The hind feet are large and completely webbed. The flat, paddle-shaped tail, twelve inches long and five inches wide, supports the animal when at work on land, and is useful in swimming and diving. Vigorous upthrust of the tail as the body is levered downward in a dive from the surface sends a cascade of water into the air, followed by a resounding slap as the descending tail strikes the water. The front teeth are designed for cutting and slicing, and are large and strong. Beneath the skin a layer of fat covers the body, insulating the animal against the cold of its aquatic habitat.

Distribution: Native to North America, remains of the beaver are found in fossil records of geologic time. Pioneer explorers and furtraders reaped a rich harvest of Idaho beaver, some parties in the early 19th century reporting a fur catch of 10,000 pelts annually in spite of the difficulties encountered in this primitive region. Records reveal nearly all streams in Idaho were the habitat of this rodent. Beaver have increased in most sections under a policy of rigid controls and a transplanting program, and the present beaver population in Idaho is estimated between 40,000 and 50,000 animals.

Food and Habits: The beaver prefers the bark of aspen, alder, willow, poplar and cottonwood trees to other foods, and usually establishes its colonies along streams where these deciduous forms occur. Pines or firs growing within reach occasionally are cut down in the absence of the favored food trees, but this type of bark generally is not eaten. The bark diet is supplemented with roots, lily bulbs and other plant forms available at the streamside.

Beaver home sites generally include a dam and lodge. The dam is built across the stream to create a pond for the protection of the lodge and its occupants. Sticks, logs, twigs, mud, and other debris are worked into place to check the flow of water, and the beaver works nightly to repair any sizeable leaks or breaks in the dam. Trees in the flooded area or along the banks are felled to provide food, and peeled sticks and twigs are added to the dam construction. Lengths of the fallen tree material are stored beneath the water line for use as fo when the pond is frozen over.



The lodge, built of sticks enmeshed and cement with mud and other materials, is situated near deep w ter with an entrance below the water line, and m shelter several beaver. These houses may be from to ten feet across and up to six feet high. Walls a usually thick, and after freezeup time, will protect t beaver from prowling predators. During the winter t animals do little except feed on the stored food suppl Beavers also use burrows in the stream banks for hou ing and feeding stations. These burows generally ha an opening for ventilation at the ground surface as w as an underwater entrance.

The litter consists of from two to six kits born in la May or June. Unlike the blind, helpless young of ma rodents, beaver young are quite mature in appearan and are active from the start. Although dependent the mother for the first few weeks, by midsummer th may be observed feeding and exploring about the lod in the evening hours. New colonies along a stream a established as young beaver in their second year a forced to leave an overcrowded home area.

Economic Value: Although the beaver is an importa fur producer, its greatest value lies in its stabilizing fluence on streamflow. Beaver ponds along a strea create fishing pools and provide the basis for increas growth of vegetation which strengthens banks and i proves habitat for other mammals and birds. These r ervoirs slow down the spring runoff on the watersh maintain the life of streams and springs and genera have a good effect on the underground water table. B ver ponds serve as catch basins holding the topsoil the watershed instead of permitting it to escape dow stream. Erosive power of streamflow is greatly reduc on watersheds stocked with beaver.

Properly managed, the beaver could prove to be great economic value to the logger, the stockman, a the farmer alike by materially prolonging the product life of the land on a given watershed.

In Idaho beaver are harvested by allotment trapp appointed by the state. When damage cases arise, animals are livetrapped and removed to other ar where an increase in beaver is desirable. Special p mits are also granted landowners to remove beaver their own land.

Animals of Idaho

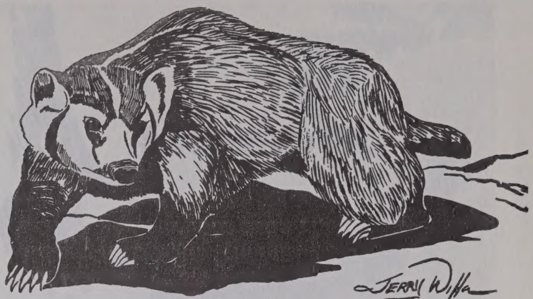
THE BADGER

(*Taxidea taxus*)

HE BADGER is an extremely interesting ıber of the weasel family, although not too understood and appreciated. It is a stocky, animal built close to the ground, and erfully muscled. The wide-spaced ears are t and rounded, the face is marked with k and white, and the long, coarse fur is ry, grizzled with darker colors. The thick and heavy claws provide able support to strong jaws when danger threatens. The is short and is carried aloft when the ani- is aroused. Length of the badger varies 1 25 to 30 inches; the short legs lift the ani- a scant nine inches in total height. Badgers h about 15 pounds at maturity, sometimes nuch as 25 pounds in extremely large viduals.

ISTRIBUTION: This effective rodent her may be expected to follow ground rrels, gophers and ground-dwelling mice where in Idaho. Its burrows are a familiar t in all parts of the state, even at very high ations in the mountains. It is most abun- in our rodent-infested rangelands.

ABITS: Nature has equipped the badger a special job of earthmover in pursuit of r burrowing animals. The tough, pigeon- front legs armed with heavy claws enable animal to move rapidly underground along rail of the intended victim while the bur- behind the badger is plugged with the n earth of its digging. It soon overtakes devours the gopher, ground squirrel, se, rabbit, skunk, weasel or other den ller unfortunate enough to attract the at- ion of this hungry predator. In Idaho the mbian ground squirrel is probably the ber one item on its diet, as these fat ro- s abound from the Snake River plains hward throughout the state. No doubt e are some birds eggs and nestings eaten along with the insects, carrion, snakes rodents. Badgers are not wholly nocturnal, may be seen hunting during the day.



The mother badger produces one litter annually, in early summer, numbering from one or two young to as many as six or seven. The den is a dry, comfortable chamber at the end of a long deep tunnel where the mother feels her brood is secure.

The young badgers open their eyes after a month or more of helplessness, grow rapidly, and may be seen sometimes in late July or August exploring the home area near the burrow's mouth. The mother is courageous in defense of her young, and it is said that the average dog is no match for an adult badger. If a man should attempt to prevent a badger from reaching the safety of its burrow, he usually finds the animal quite willing to fight for the right to pass, and will not be stopped from reaching the den site.

Badgers in steel traps often dig themselves in so effectively that a man canot pull the animal loose with the trap chain. A captive badger in a college laboratory escaped from a strong wire cage and spent part of a night looking for a way out of the locked room. In its prowls it moved two large storage cabinets away from their place against the wall, cabinets so heavy that the efforts of four men were required to replace them, upset a quantity of chemicals and finally ate its way to freedom through the panels of an outside door. If the badger is not as powerful as its weasel cousin, the wolverine, it certainly stands in close second place for the title of "muscle man" of the family.

Fur of badgers is not considered of high quality, but is serviceable in the fur trade, and formerly the hair was used in the manufacture of fine shaving brushes.

Ranchers and farmers have found the burrows of this busy animal often a hazard to irrigation and other farm practices, a fact which reduces somewhat its known value as a rodent exterminator. It is not protected in Idaho.

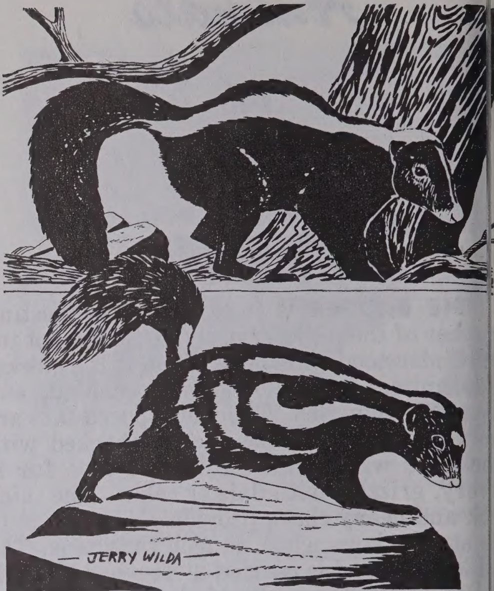
Animals of Idaho

THE STRIPED SKUNK, (Mephitis mephitis) is a chunky, deliberate member of the weasel family weighing 7 to 10 pounds when grown, and measuring about 25 inches in length. The head is small and pointed and the ears are small. The skunk's legs are rather short and widely spaced, and this feature combined with the possession of rather long body fur gives the animal a thickset appearance. The front claws are strong for digging.

In some specimens the glossy fur is entirely black, but ordinarily the skunk is marked with white on top of head and neck, the white dividing to form a stripe down each side of the back and onto the tail. As the animal moves along with rolling gait the tail is carried low, the long, plumelike hairs at the tip usually touching the ground. If alarmed or startled, the drooping tail is lifted. The skunk possesses a pair of scent glands capable of discharge in the direction of an enemy, and it can move rapidly when the need arises.

Skunks are most active at night. At dusk they may be seen hunting for food along roadsides or wandering near protective cover in the fields where they dig out insects from the loose topsoil or take them from the dew-chilled grass, as insects comprise about 40% of the diet of this mammal. Fruits, berries, grains and other succulent plant parts make up another 30% of its food where available, and mice are taken in large numbers. Nestlings and eggs of birds make up only about 2 to 3 per cent of the food of skunks, studies have revealed. When established near farm buildings, they sometimes learn to take poultry, and may develop a taste for hen's eggs.

During the day skunks retire to a den site in a burrow, among rocks or under logs or buildings. In periods of cold weather they curl up and become drowsy, but do not truly hibernate, and warm weather brings them out again. The mating season is in February and March, at which time they are active and travel extensively. The young are born naked and blind and remain helpless in the den for several weeks. The brood may number from 4 to 10 young.



LITTLE SPOTTED SKUNK, (Spilogale gracilis)
called “civet cat” by trappers, is an active skunk a
two-thirds the length and one-third the weight o
larger, striped cousin. The glossy black fur is ma
with a broken pattern of white spots on head and
and at the end of the bushy tail. Its musky scent is
as strong as that possessed by other skunks.

This little animal is more strictly nocturnal than
striped skunk but the habits are similar. It eats ins
mice and other small animal forms. Average litter
tains 5 or 6 young, born blind and helpless in sp
The home is a den in burrow, rock pile, hollow lo
stump. After a few weeks in the den the young em
with the mother for nightly forays. One such fa
of four young with the mother was seen in the li
of the car on the highway near Riggins. Three of
agile young were captured before the mother was
to lead them to safety in the darkness. At this t
mid-June, these young measured about 9 inches lon

Like the striped skunk this species is found in
parts of the state although it is nowhere common.
fur is not in demand by trappers.

Skunks are known throughout Idaho's agricult
sections, although trappers report fewer number
these animals now than in the early 1900's. They
not classed as furbearers in our state, but the fur
durable as that of mink and once was popular in
trade under the name of “Alaskan sable” or “black
ten.”

Furbearers of Idaho

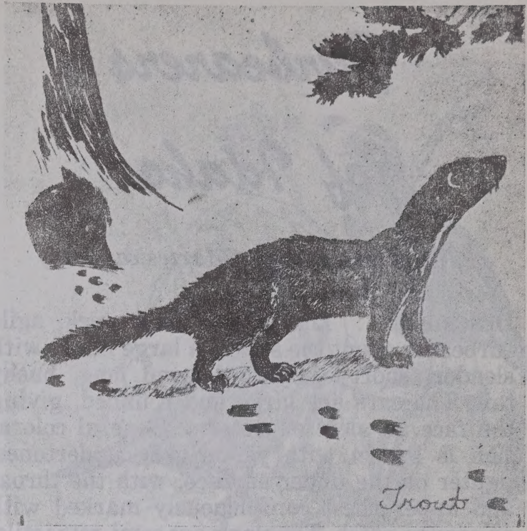
THE MINK

(*Mustela vison*)

RIPTION: This weasel-like carnivore is
what smaller than a house cat, with short
long neck and body, and long, semi-bushy
The head is small, with pointed muzzle
small, alert ears. The fur is soft and
e, well covered with shining guard hairs.
r ranges through russet brown to a dark
olate brown, lighter below, with a small
n of white in the region of chin and throat.
ure males weigh up to two pounds. Fe-
s are smaller.

RIBUTION: The mink is found throughout
o, and is fairly abundant in areas of suit-
habitat along watercourses and in the
ity of lakes, reservoirs and marshes
e protective cover exists.

AND HABITS: The mink is semi-aquatic
abits, and swims well. Its range during
year may cover many miles, as it is an
e traveler, preferring to move at night
sometimes observed during the daylight
s. An individual mink, or family group,
occupy a portion of the range for several
before moving on to another temporary
ion. Headquarters may consist of a den
a streamside, a cavity among roots or in
ocks, or an unoccupied burrow of another
al. Sometimes a muskrat house is used.
and the mink frequently covers long dis-
s with its graceful, bounding gait, but is
y found any great distance from water.
y food the mink can capture and kill is
dered fair game: birds, rodents, various
of aquatic life. Like its smaller cousin,
veasel, it will store its meat in the den
hunting is good, to feast on this supply in
re. Mink dens have been unearthed con-
ng a wide variety of prey. One mink that
ed access to a holding pond at a fish
ery destroyed a number of fish in a short
by taking a sizeable bite from each, leaving dead and dying fish in its wake as it went through the pool.



The mating season is at its peak in March in Idaho. The young are born in April or early May. The litter averages five or six young. Blind and helpless at birth, young mink open their eyes at about the end of the fourth week of life, and at that time begin to subsist on solid food. When old enough to travel young mink accompany their parents on their daily and nightly wanderings. During this training period the young develop rapidly. Adults have been observed in the water ferrying young on their backs. Although the young mink exhibit considerable play instinct at this time, adult mink are typically unsocial except during the mating season, and spend much time alone. Like the other weasels, mink possess scent glands which can exude a musk of very offensive odor.

Economic Importance: The fur of the mink is beautiful and durable, and currently commands top price among Idaho furs. Estimated annual catch of Idaho mink is upwards of 5,000 pelts. The trapping of mink has been restricted to alternate years to protect this valuable resource, and under the present program numbers are holding up well.

Nationwide fur industry reports indicate more than one-third of all mink fur produced are ranch mink, which generally bring higher prices than the wild furs. Currently there are more than fifty mink farms in operation in Idaho.

Furbearers of Idaho

THE MARTEN (*Martes caurina*)

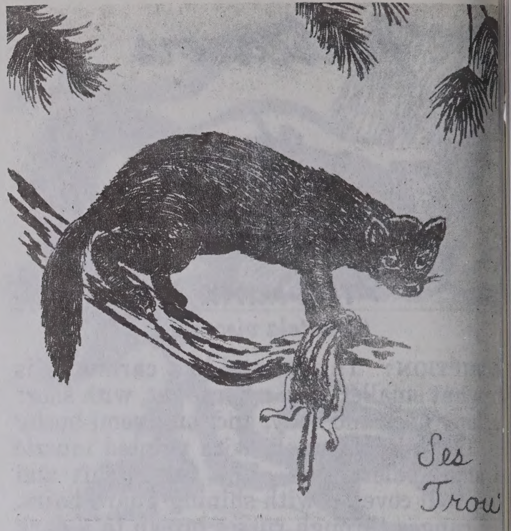
DESCRIPTION: The marten is a quick, agile furbearer about the size of a large mink, with slender, short-legged body and long, bushy tail. The ears are large and rounded, giving the face an alert expression. General coloration is brown with yellow-grey undertones, lighter on the under surface, with the throat and upper chest conspicuously marked with an orange patch. The claws are semi-retractile.

DISTRIBUTION: Found in Idaho in the mountains, from Canada to Wyoming and Utah, the marten prefers a timbered habitat at higher elevations.

FOOD AND HABITS: This interesting member of the weasel tribe is an adept tree climber and can outjump and outrun the nimble pine squirrel, a preferred item on its diet. Any small prey it can catch in the forest is acceptable, including rodents, rabbits, birds, insects, frogs and other forms. Even some fruit may be taken. It is known to eat chipmunks, rats and mice, marmots, shrews, birds up to the size of grouse and ducks not too large to be stalked and killed.

The marten does not hibernate and is on the alert for food at all seasons. Unlike the mink, it dislikes getting into the water, and when hunting along a mountain stream it avoids getting its feet wet, nimbly following the logs strewn along its way. It is most commonly found among the trees along the mountain ridges in preference to the canyon bottoms.

Like the other weasels this furbearer possess scent glands from which is exuded a strong, musky scent when the animal is excited or in trouble. Because of its alertness and vitality the marten has few enemies of importance. Occasionally one may fall prey to coyote, lynx or bobcat, and the larger hawks and owls, and golden eagle are classed among its predators.



The fisher, a large marten-like weasel abo the size of a fox, formerly was found in Idah and preyed upon the marten it is said. T fisher, like the marten, is arboreal in habi and is able to overtake and capture it.

Martens mate in late summer, but t young are not born until the following Apr due to a delayed or suspended gestation peric This unique characteristic is observed on among the weasels, i.e., in the badger, fishe weasel, and to some extent in the mink a wolverine. The reason for this trait is n known.

The average marten brood is two or thr young, born in a hollow log, snag or burro and are blind and helpless during the first fo or five weeks of life. During the summer th are active and playful, but as they grow old their natural ferocity develops. By fall, th are able hunters and leave the family group.

ECONOMIC IMPORTANCE: Marten fur is val able in the fur trade, and the animal has lo been an important furbearer in Idaho. Duri the past decade it has been necessary for t commission to limit the trapping of marten alternate years to protect the species. The f has been called American sable because of resemblance to the true sable of the Siberi pine forests.

Trapping reports indicate Idaho mart have produced about 1,100 pelts annually the regular open trapping seasons since 19

Game Birds of Idaho

VALLEY QUAIL

(Lophortyx californica vallicola)

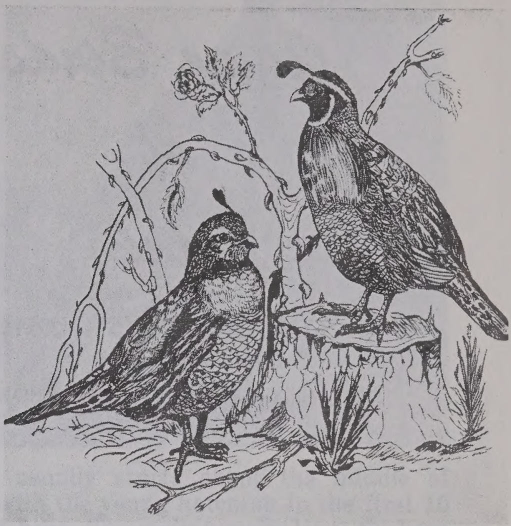
Other Names: CALIFORNIA QUAIL, BLUE QUAIL, CRESTED QUAIL, TOPKNOT QUAIL.

DESCRIPTION—The male of this species is an olive-gray color, with olive-brown wings and flanks and a blue-gray breast. The black throat is circled by a white line which crosses the face above the eye. Upper belly, buffy, light colored lines across flanks; lower belly, a rich chestnut. Females are brownish and lack the facial markings on head and throat.

The topknot is black in the male and brownish in the female. In both sexes the plume curves forward to dangle over the forehead. In ordinary light the bird appears slate colored, hence the name blue quail.

RANGE—In southern Idaho this quail occurs locally along watercourses of the Snake River valley from about the middle of the state to the Oregon line.

In northern Idaho, coveys also occur in limited areas along the lower Snake and Clearwater rivers. Published reports reveal occurrence of this quail in the Clarkia and upper St. Joe river areas of Shoshone county in 1941. Blue quail reported in Kootenai county in the 1930's may have been of this species, but the birds have since disappeared.



NEST AND YOUNG—Time of nesting varies with weather conditions but usually takes place in May and June. Quail occupy definite nesting territories which the cocks defend vigorously during the incubation period. The nest is a slight depression in the ground lined with dry grass or other vegetation and generally roofed. Six to sixteen creamy white eggs, brown spotted, comprise the clutch. Average number reported in southern Idaho is 13. Six to ten young are successfully reared. Young quail are able to fly in their second week.

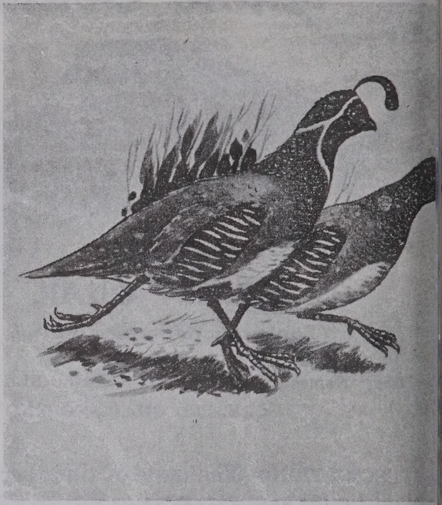
FOOD AND COVER—In their search for food valley quail scratch vigorously in ground litter where weed seed lies scattered and also secure much insect food in this way. Quail are of prime value to agriculture as consumers of weed seeds and harmful insects. Family groups remain together in the home territory as long as possible, the daily range of travel being about 200 yards in radius. The annual radius covered by the flock frequently does not exceed half a mile in extent. Restrictions in the amount of suitable winter cover sometimes result in concentrations of numbers as high as 100 birds in a local area.

Game Birds of Idaho

THE GAMBEL'S QUAIL

(Lophortyx gambeli)

Other Names: DESERT QUAIL, REDHEAD



DESCRIPTION — This species is similar to the valley quail in general markings and has the same forward-curving plume. The male has a brighter reddish-brown color on the top of the head and a black patch against the buff of the belly which is lacking in the valley quail. Flanks are reddish-brown streaked with white.

RANGE—The Gambel's quail is found in Idaho only in Lemhi county in the vicinity of the junction of the Lemhi river with the Salmon. Here it occurs in river bottom tangles of superior quail cover at an elevation of approximately 4,000 feet.

The bird was introduced into the area in 1921 by local sportsmen who secured the stock from southern Nevada sources.

NEST AND YOUNG — Mating habits of the Gambel's quail are similar to the valley quail. The nest is the usual lined hollow with a clutch numbering ten to twelve eggs, whitish, blotched with brown. The striped-backed chicks are alert youngsters which may be flushed with their mother at the edge of the tangled thickets which are always found in the home territory. Family groups return at night to the briers which provide roosting protection.

FOOD AND COVER—Quail cover alon
Lemhi where these birds live is of a
impenetrable quality that defies the
pling of livestock. This explains how
birds have survived through the year
habitat so far north of the normal
of the Gambel's quail. Creek bank
bottom edges are lined with bunch
willow thickets, brush piles, bramble
vines in which quail are able to find
tuary at all seasons. When the snow i
the birds find dry passageway th
these tangles. Grazing livestock ar
able to reach all the forage in such ta
so that during the winter season
weed seed is assured the quail.

It is the hope of the game depar
that more and more people in the sta
recognize that the most serious ha
to quail propagation is the shortage
right kind of bramble cover. Quail a
great travelers and when the cover
areas is removed, the existing popu
rapidly dwindles or disappears. Spo
and farmers can aid in bringing ba
quail by restoring bramble thickets in
areas and thus provide the quai
needed cover.

Game Birds
of
Idaho

THE CHUKAR PARTRIDGE

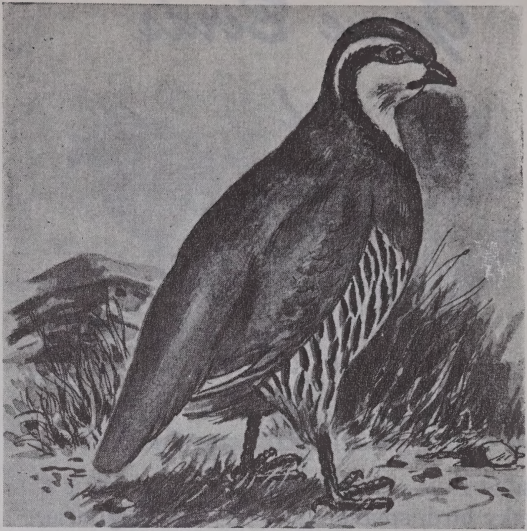
(Alectoris graeca chukar)

er names: CHUKAR; RED-LEGGED PARTRIDGE

IPTION—Plumage of the adult chukar is grayish brown with a bluish cast on the . A wide black line starts above the opening and passes through the optic continuing down the sides of the neck cross the upper breast where the two join. Conspicuous markings are the al black bars on the lower sides and of this bird. These are prominent t a creamy-tan background. Tail feath- e sienna colored. Ear tufts are brown. eak, legs and eyelids are red. Both male emale are colored alike. Chukars are hat larger than the Hungarian part- and their unusual markings should pre- heir being confused with any other Idaho bird.

E—Introduced into the United States India in 1893, the chukar partridge has proved its ability to survive and multiply gh, semi-arid regions where cheatgrass ndant. They have become well estab- in Washington and Nevada with partial s in Idaho, Colorado, California and ing.

first releases in Idaho were made in erce county in 1933. Releases have been n 23 counties of the state with the great- ccess attained in Gem county, particu- n the Squaw Butte area.



AND YOUNG—The nest is a depression ground with a lining of dried grass and feathers. It is usually located under rowing vegetation. Chukars seem to south-facing slopes for nesting. The ge number of eggs in the clutch is about he incubation period is 24 days. Egg laying usually starts about the middle of April with the young hatching in the first 10 days of June. The cocks usually leave the hens sometime after the egg clutch is complete although some may remain in the vicinity until the brood is nearly hatched. The young are led from the nest immediately after the hatch and are quick in movement and proficient at hiding. They usually can fly at two weeks of age.

FOOD AND COVER—The chukar's main diet consists of grass, leaves and seeds, particularly those of cheatgrass. They also utilize weed seeds and small fruits. Broods feed over a relatively small area after the hatch, usually staying in brushy cover. Chukars are capable of scratching through rather deep snow in search of food.

The range of the chukar is limited by the availability of water in summer months. They tend to congregate in large flocks at watering sites when other water holes and streams dry up in late summer.

Chukars prefer a living area with cheatgrass, bunchgrass and sagebrush. They like rock outcroppings, cliffs and bluffs with brushy stream bottoms and swales.

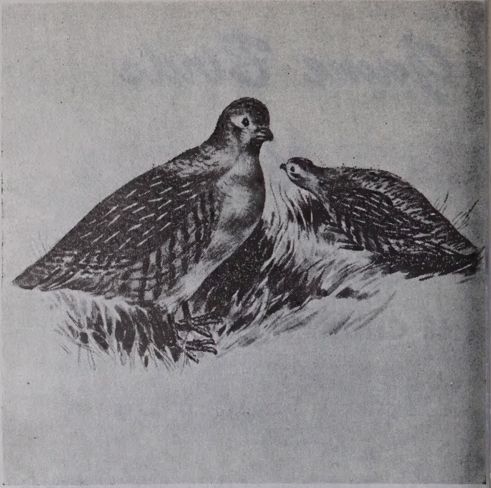
VALUES—The chukar is considered a fine game bird from a sporting angle. They have a tendency to run uphill from hunters and when flushed exhibit flight characteristics similar to that of the Hungarian partridge. They are important in that they live in areas that have not formerly supported large populations of other game birds.

Game Birds of Idaho

THE HUNGARIAN PARTRIDGE

(*Perdix perdix*)

Other names:
HUN, EUROPEAN PARTRIDGE, GRAY PARTRIDGE



DESCRIPTION—The Hungarian partridge is a chunky bird, smaller than any of the grouse, but larger than quail, measuring 12 to 14 inches in total length. Plumage is grayish, barred with chestnut on the sides, lower breast and flanks. In flight the chestnut outer tail feathers provide a good field identification mark. Sexes are similar in size and color, except for slight differences in striping on the wing coverts. In the females, wing covert feathers have buff crossbars which are not present in the males.

RANGE—The Hungarian partridge is well distributed throughout the agricultural areas of the state. They apparently moved into Idaho from Oregon and Washington as introductions were made in those states about 1900. Additional introductions and transplants have been made within Idaho since that time. In southwestern Idaho, Hungarian partridge broods have been found at high elevations in aspen groves more than fifty miles from the nearest cultivated land.

Over much of its former range this bird has decreased in numbers. These declines may be due to changes in farming practices on lands that were originally more suitable for game birds.

NEST AND YOUNG—Huns pair in late January and early February. Rivalry among males is expressed at this time. Courtship display b fore the females includes strutting and spreading of the chestnut tail feathers. Tl covey is broken up prior to mating and tl paired birds select a nesting site.

Alfalfa stubble, wasteland or grassy fenc rows are selected for nesting sites. A well co cealed depression lined with dried grass ar feathers may contain up to eighteen eggs. Tl male accompanies the female and the your birds and remains a member of the fami group. When danger threatens, both adul scold and feign injury to draw the intrud away from the young birds. The alarm note sharp and metallic, and is accompanied by flirting of the tail feathers.

FOOD AND COVER—During the growth peri young Huns require large amounts of inse food and green vegetation. Weed seeds ar waste grains become important to their di later in the summer, but Hungarian partridg relish green plant food as a part of the diet all times. In January the coveys may be o served working their way down through t snow in search of food items. If weed seeds ar grain are available, Huns will remain on op prairie lands during the entire winter. If co ditions are too severe, a covey will usual make a move to more suitable areas for fo and cover.

Game Birds of Idaho

THE FRANKLIN'S GROUSE

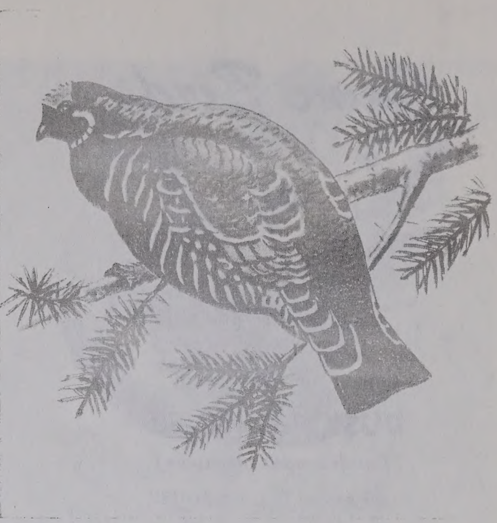
(*Canachites franklini*)

Other name: FOOL HEN

SCRIPTION—Although Franklin's grouse newhat resembles the large blue grouse h which it is associated, it is smaller and ker than the blue grouse. It is actually re closely related to the spruce grouse of nada.

n addition to its darker plumage, Frank- s grouse is distinguished by black and ite tail coverts that may be seen at ordi- y distances and serve as a good field rk. The spot above the eye is more reddish the Franklin's grouse than in the blue use. Average length of the Franklin's use is 15 to 16 inches. The upper parts dark, broadly marked with black bands l narrower bars of gray and brown. Tail thers black to tip, or narrowly edged h white; throat and chest black, with ite band between.

NGE—This bird of the big timber and h mountains is sparsely distributed over northern two-thirds of the state, being nd as far south as the Seven Devils area ng the Snake River and in the mountains central Idaho. It is also found along the theastern section of the state to the Wyo- ng and Utah borders. It is limited to the her elevations.



NEST AND YOUNG—Due to the elevation at which the Franklin's grouse nests, broods of this species are often hatched later than other grouse. Spring courtship antics include wing drumming somewhat in the manner of ruffed grouse. Nests are on the ground at the edge of thickets or alongside streams in high mountain meadows. A clutch of eight to fifteen eggs, spotted and blotched with brown, is usually completed by mid-June. The young birds appear in early July. Family units consisting of the mother and several young have been observed together in late September and early October, frequenting the vicinity of springs and seeps along the slopes of high ridges.

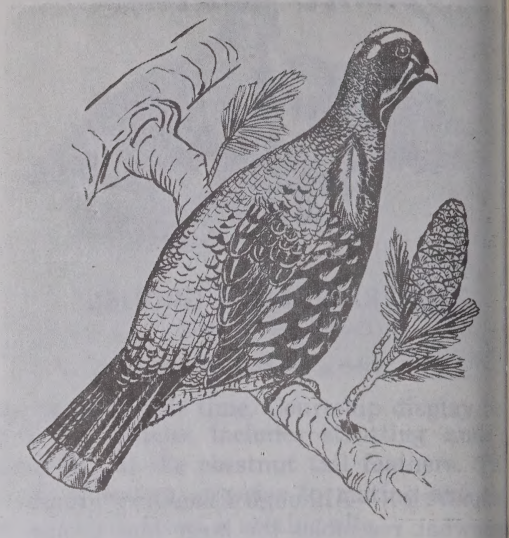
FOOD AND COVER—Like the blue grouse, this bird subsists on succulent plant materials, berries, seeds and insects in season. The leaves of evergreen trees and shrubs is the main food used during winter months. Fir, spruce and larch needles are eaten the year around. Both food and cover are provided the Franklin's grouse in its mountain habitat wherever dense boughs of alpine and Douglas fir and alder thickets are present.

Game Birds of Idaho

DUSKY GROUSE

(Dendragapus obscurus)

Other name: BLUE GROUSE



DESCRIPTION—The general coloration of this large-sized wood grouse is dark grey. The male is darker than the female, in some lights appearing a dark slate blue. Although the average weight is about two pounds, some males exceed four pounds. Air sacs on the necks of the males vary in color from orange to red when distended.

RANGE—Two forms of the blue grouse occur in Idaho, the dusky grouse of the southeastern part of the state and the race known as Richardson's grouse of the mountainous northern and central sections. The dusky grouse is distinguished from Richardson's by the wide, pale band near the tip of the dark tail, which is lacking in the northern form.

Blue grouse are found in most of the forested uplands of the state, preferring remote regions where mature stands of pine, fir and other conifers offer good winter cover. They are most abundant in northern and central Idaho where semi-primitive conditions of timber growth still exist.

NEST AND YOUNG—Blue grouse are polygamous in mating habits. In the spring males may be heard hooting, a hollow sound that carries far in the timbered canyons. During this performance the air sacs on the necks are greatly distended and the wings are carried loosely at the sides. When on the ground the hooting and courtship demonstrations sometimes include a short, erratic leap into the air, suggesting a back somersault. Usually the hooting is done from a place of concealment in a tall, dense conifer and may be carried on periodically for hours during the mating season.

Nesting activities are conducted along lower slopes, near meadows, streams or springs where succulent plant food and insect fare for the chicks is assured. The nest is a slight hollow lined with dried plant material and perhaps a few feathers. Six to ten eggs are laid. They are a creamy buff color with red-brown spots.

FOOD AND COVER—With the advance of summer, blue grouse gradually move to higher elevations in pursuit of tender plants, fruits and insects. This seasonal movement may take the birds two or three miles and involve a vertical ascent of 2,000 to 3,000 feet. Fall usually finds them well up in the mountains.

In the winter months blue grouse feed almost exclusively on conifer needles. During periods of severe weather birds have been known to remain for days and even weeks in the same dense Douglas fir.

Game Birds of Idaho

SAGE GROUSE

(Centrocercus urophasianus)

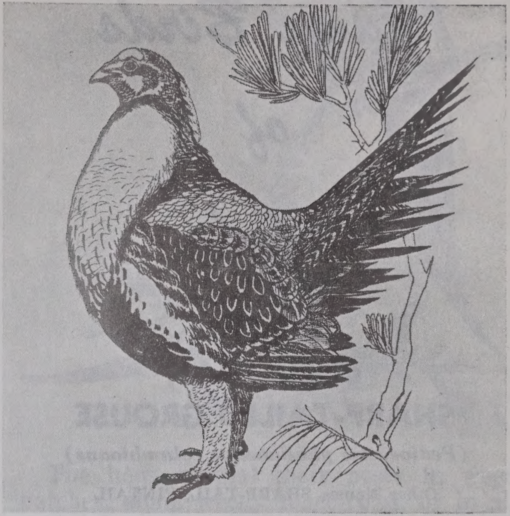
r Names: SAGE HEN, COCK OF THE PLAINS

RIPTION—The sage grouse matches the r of sagebrush very well, with the upper s a blend of grey, buff, brown and black. white breast and black belly charac- e the large cocks. Males also possess lder ruffs and pale air sacs.

his bird is the largest grouse in North rica. The cocks measure from 26 to nches in overall length and females 21 3 inches. Weights of five to eight pounds been recorded for males of the species. feathers are sharp and pointed, as ied by the name "urophasianus" mean- "pheasant-tailed." The legs are feath- to the toes.

GE—Sage grouse in Idaho are found h of the Salmon River in semi-arid sage- h country, chiefly in Butte, Camas, k, Custer, Fremont, Blaine and Owyhee ties. Additional scattered flocks may ound locally across the entire southern ns section of the state.

T AND YOUNG—Male sage grouse appear "booming" or strutting grounds in ch. Here, year after year, birds num- ng half a dozen to 50 or more perform resting courtship antics starting at day- k, and continuing for several hours if disturbed. Yellowish air sacs are in- d giving the upper body a pouter pigeon t, while the wings are held in a droop- position at the side. During the strut- performance the air sacs are filled and tied accompanied by a vigorous throw- movement of the head and neck, resulting in a sharp booming sound. Hens walk about the strutting ground in apparent unconcern as the cocks strut, boom and indulge in small fights with their rivals.



Egg laying usually begins in April. Seven to nine is the usual number. Eggs are pale green, marked with brown spots. Nests are usually located on gradually sloping sagebrush covered hills and most often are built at the foot of a sagebrush under an overhanging limb. The nest is lined with dry grass, sagebrush twigs and leaves if available. After incubation starts, breast feathers from the female are added to the lining.

The incubation period is about 25 days. Hatching begins shortly after the first of May, and may extend until the first of June. The young birds are downy; grey colored with darker brownish black spots. When they are ten days old, the chicks can fly 50 feet or more. They are continually on the move hunting for insects, tender green buds and seeds. Water obtained from succulent vegetation, rain and dew seems to meet most of their moisture requirements.

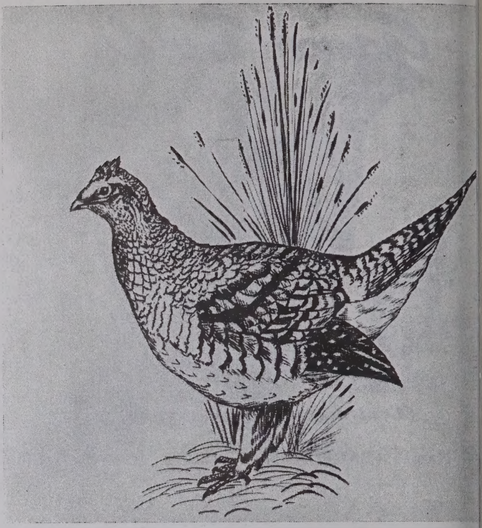
FOOD AND COVER—Sage grouse move from low to high elevations with the change in season, but they are always associated with sagebrush. During the summer a large portion of their diet is made up of dandelions, clover, insects and green leaves. In fall and winter their main food is sagebrush.

Game Birds of Idaho

COLUMBIAN SHARP-TAILED GROUSE

(Pedioecetes phasianellus columbianus)

Other Names SHARP-TAIL, PINTAIL



DESCRIPTION—The sharp-tailed grouse is a light colored, rather speckled grouse of the open country, smaller than the hen ring-necked pheasant and with a shorter tail. Its name is derived from the fact that the middle tail feathers are longer than the others. The mottled plumage of black and buff markings blends well against sagebrush, prairie grass or grain stubble. Males generally are slightly larger than the females. The sexes are similar in coloration.

RANGE—Sharp-tailed grouse formerly occurred on Idaho grasslands in large numbers, but its desirability as a game bird, together with man's present use of the land for agriculture, has restricted this fine bird to only a small part of its former range.

At the present time it is known to occur in six counties in southeastern Idaho with the greatest numbers near the Sand Creek Refuge in Fremont County. A few others periodically are reported from the Squaw Butte and Crane Creek region of southwestern Idaho, and from Kootenai county in the northern Panhandle. With present land use practices it is doubtful whether the sharp-tail will ever again be very abundant in any area in Idaho. The bird does not penetrate deeply into wooded country, but prefers grassland with bushy ravines.

NEST AND YOUNG—The group courting antics of this bird in some ways resemble those of the sage grouse. On the strutting grouns in April and May males perform interestig dance routines and carry on spirited batts with rivals. In the dance the air sacs are dtended, the tail is spread and the wins droop loosely at the sides as the cock bi shuffles and struts before the hens. Wi head and neck lowered and outstretched, te cock makes quick short runs across te strutting ground, ending in an abrupt hf circle to the accompaniment of an audile rustling of the tail feathers. The perforance is carried on during early morning ad late afternoon hours.

The nest is apt to lie in a poorly conceald depression on sloping ground in open graland and be lined with dry plant mater and feathers. Ten to fifteen eggs are la creamy buff in color, sometimes finely dted with brown markings. The first youg appear in late June. As in the case of ot grouse the chicks feed on vegetable mater and insects and develop rapidly.

FOOD AND COVER—Sharp-tails feed on sees waste grain, browse and berries during fall. The birds flock together, and when w ter approaches, may spend much of th time in trees picking buds and fruits. D ing the winter season they seek the prot tion of trees and bushes lining the wat courses on their habitat area. Like some the other grouse, they sometimes find warm bed beneath the snow.

Game Birds of Idaho

CHINESE RING-NECKED PHEASANT

(Phasianus colchicus)

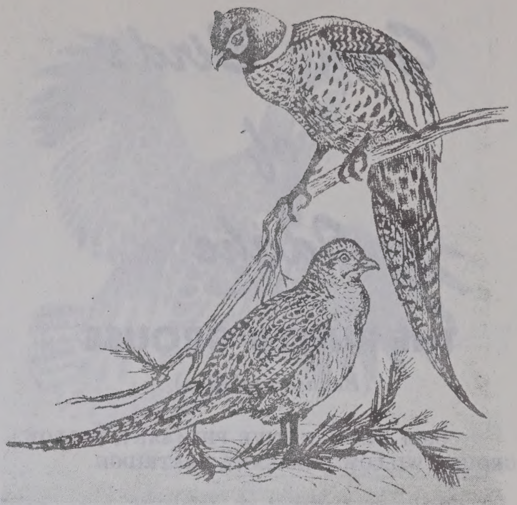
Other Names: RING-NECKED PHEASANT,
CHINESE PHEASANT, RING-NECK, CHINK

ESCRIPTION—The cock ring-necked pheasnt is a strong, handsome bird with a sweepg, pointed tail. The greenish head, conpicuous ear tufts, white neck ring and pper breast, make this bird stand out herever observed. The back is a blend of ark colors, predominantly reddish and ray. Females are smaller, gray-brown, rouse-like birds with a shorter tail.

ANGE—First introduced into Idaho on the learwater River drainage near the town of amiah in 1903 and in the next few years various other parts of the state, the ring-ecked pheasant multiplied rapidly. Huntg was first permitted in 1916 in Ada, Canon, Gem, Gooding, Latah and Nez Perce ounties. By 1930 the pheasant was well stablished in all agricultural areas of the tate and is now considered the most imortant game bird in Idaho.

Area of greatest concentration today are he irrigated lands of Canyon, Ada, Gem and Vashington counties in southwestern Idaho, nd Lincoln and Gooding counties on the nake River plains. It is estimated that fall opulations in these areas have reached 50 irds per 100 acres in some years.

EST AND YOUNG—Pheasants are polygamus. Cocks begin to display rivalry during ebruary as the winter flocks start to break p. By early March the roosters have esablished individual "crowing territories" to hich hens are attracted. A cock is often bserved in company with several hens.

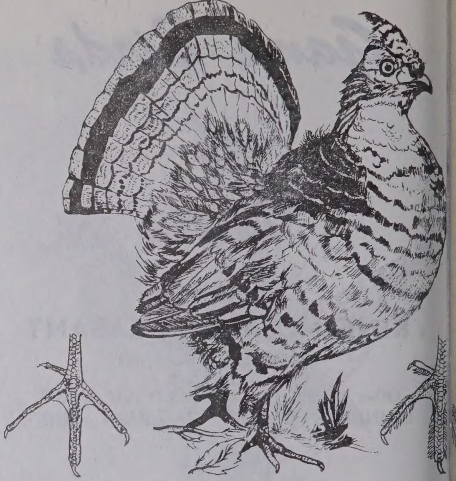


The hens conceal their nests in weed patches, along weedy fence-rows, or in alfalfa, clover or grain fields. Nests may contain 10 to 14 olive brown, unspotted eggs. The peak of the hatch usually occurs in June. Pheasants produce only one brood a year. Re-nesting is not done unless a hen loses her original nest or brood.

FOOD AND COVER—Young pheasants require a large proportion of insect food, and at any age seek some green "salad" foods in their diet. Mature birds take any available vegetable food, weed seeds, grains and tender plant parts. Most grain utilized is waste gleanings from stubble fields after the grain harvest. The pheasants' food habits generally are beneficial to agriculture.

Pheasant populations in some areas of the state have declined under what was present 10 or 15 years ago. This decline has pretty well coincided with more intensive farming practices being adopted by land owners. It is believed that the removal of brush in draws, odd corners and along fence-rows, and the corresponding loss of food and cover, has had a direct effect on the ability of any section to carry pheasants over the critical winter months. The Department is currently attempting to replace some of this cover with a habitat improvement program. The ability of certain areas to continue to support huntable pheasant populations will depend upon the success of this program.

Game Birds of Idaho



THE RUFFED GROUSE

(*Bonasa umbellus*)

Other Names: NATIVE PHEASANT, WILLOW GROUSE, WILLOW PHEASANT, PARTRIDGE

DESCRIPTION—The ruffed grouse in Idaho is a gray-brown bird with a fan tail. It is characterized by a deep black cape or ruff conspicuous on the sides of the neck. The plumage is mottled and barred with brown, and the tail is crossed near the tip with a broad black band. In the female, the ruff is shorter and the center of the tail band is broken. A ragged crest of feathers on the head is typical of the ruffed grouse. Smaller than the ring-necked pheasant, this bird weighs between 18 and 25 ounces.

RANGE—In the spring the drumming of the male is heard in sections of the state where stream-side thickets of birch, alder, hawthorn and other growth provide the food and cover the birds prefer.

Best ruffed grouse range in Idaho is found in the northern counties, but the bird occurs in other parts of the state where rainfall is sufficient to support ample woodland cover. A bird of the forest edge, it finds suitable habitat in brushy re-growth on cutover forest lands and may be flushed along borders of lowland meadows supplied with succulent buds, berries and running water.

NEST AND YOUNG—The explosive sound of the grouse's drumming wings suggests the warming up of a reluctant gas engine somewhere in the neighborhood. In
manner the male each spring announc
the world the establishment of a home t
tory. When a female approaches the d
ming site, the male may leave his perch
strut toward her with tail spread wide
black ruff fluffed to its fullest extent.

Eight to fifteen brownish buff eggs
concealed in a depression near a st
brushpile or log. Peak of the hatch oc
before mid-June in Idaho. As with the
grouse, these chicks follow the mothe
search of food shortly after the natal
is dry. Flight quills sprout immediatel
the young are able to fly when but a
to ten days old.

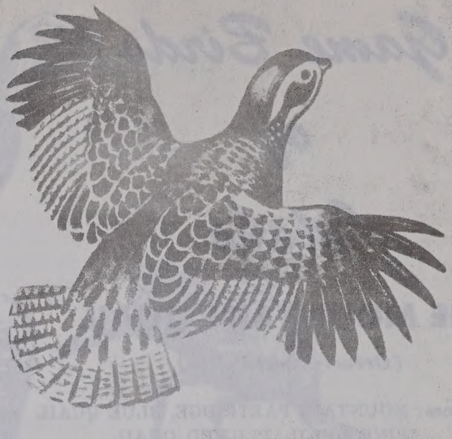
FOOD AND COVER—Broods usuall
not stray far from the protective cov
brambles or dense low thickets bord
clearings where insects and vegetable
may be secured. In August family unit
come disorganized and young birds far
themselves.

Wintering flocks are found in the sh
of mixed evergreens and deciduous
where a variety of needles and buds is a
able. The birds often roost beneath
snow. In winter, horny processes grov
along the toes of grouse to provide b
footing in snow.

Game Birds of Idaho

THE BOBWHITE QUAIL

(*Colinus virginianus*)



CRIPTION—The bobwhite is a small, rus-
olored quail lacking the crest or plume of
r quail in Idaho, and is much smaller
the ruffed grouse or Hungarian par-
ge. The Male has a white throat under-
ed with black, and a conspicuous white
through the eye; the female is marked
buff instead of white in these areas.
tail of the bobwhite is short and round-
The brown back is boldly marked with
k. The bobwhite is a quick, alert little
l, startling swift on the wing when
hed.

GE—Bobwhite were introduced into
o Territory in the Boise River valley in
by local sportsmen. Ten years later
irds had spread in suitable habitat over
rea 100 miles across. Boise valley of-
d more escape cover for quail at that
than it does now.

t the present time this quail is found
g the lower Boise, Payette and Weiser
r drainages and along the Snake River
r east as Glenns Ferry. The resident
lation in the southern part of the state
y probably originated from the Boise
y introduction. In northern Idaho the
is resident along the Clearwater River
ream from Lewiston.

NEST AND YOUNG—Bobwhite are monogamous. Paired birds leave the winter flocks in early spring. Unmated males may be heard calling in April and May. Mated birds are silent. The nest usually is concealed under dried grasses or weeds. Ten to twenty white eggs may be laid. Young quail are very active in search of food and are usually able to fly within ten days after hatching.

FOOD AND COVER—Bobwhite quail eat vast quantities of weed seeds and insects and are considered among the most beneficial birds on the farm. Wild fruits and grain are taken when available. It has been determined that desirable quail habitat include the following: (1) Feeding areas, weedy and open, where seeds and insects are numerous, near or in cultivated land, and preferably with some running water. (2) Resting and loafing areas providing shade and dusting spots during the siesta midday period, and (3) Dense escape cover, preferably of bramble type heavy enough to discourage dogs or predators, and in which the covey, huddled together for mutual warmth in the winter, may roost without fear of being molested.

Game Birds of Idaho

THE MOUNTAIN QUAIL

(Oreortyx picta picta)

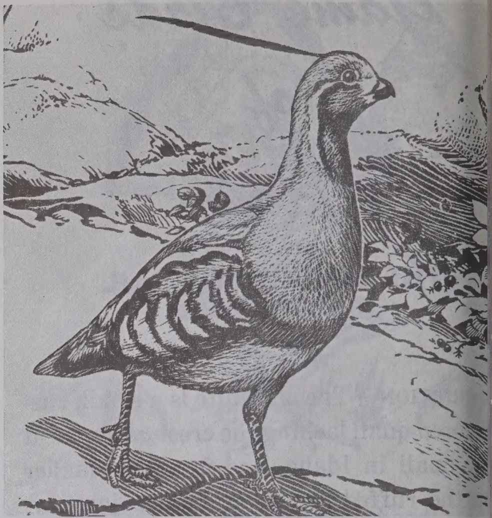
Other Names: MOUNTAIN PARTRIDGE, BLUE QUAIL
PINE QUAIL, PLUMED QUAIL

DESCRIPTION—The mountain quail has a brown back bordered on upper sides with buff colored stripes. The throat is chestnut; flanks are chestnut barred with black and white. The breast is slate blue. Color in the sexes is similar. The most distinctive field mark is the long, black head plume of two straight feathers which serve to distinguish it from other quail.

RANGE—Although not abundant in Idaho, mountain quail occur along watercourses in the central and southwestern parts of the state.

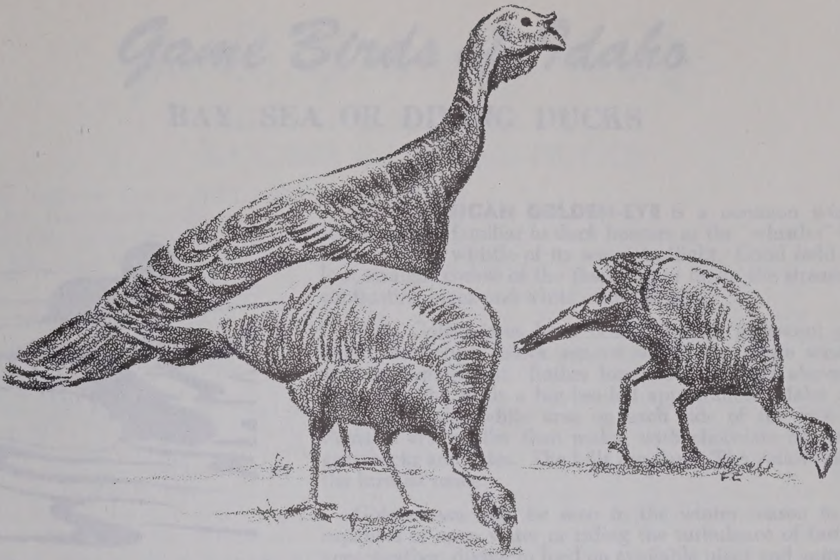
In the Clearwater river drainage of northern Idaho, mountain quail have persisted despite increasingly heavy grazing pressure and clearing of streamside tangles for agricultural purposes. Since the 1930's there has been a slow decline of the birds in Nez Perce and Latah counties. Scattered coveys may still be seen along small tributaries of the lower Clearwater and Potlatch rivers.

NEST AND YOUNG—Reports of observers indicate the mountain quail is polygamous. Nesting takes place in May and early June; the nest is a slight hollow lined with dried grass, leaves and, on occasion, pine needles, near a low bush, fallen log or base of a tree. Average number of eggs is ten or eleven, with maximum of 15 reported, of creamy buff, unmarked. On the steep slopes above



the Potlatch river in southeastern Lata county, family groups occasionally may b flushed in midsummer near dense hawthor thickets where springs flow the year aroun Here the chicks spend their early growt period feeding on insects and tender pla parts, close to the protection of the thorn tangle, into which they disappear when dis turbed. Similar streamside tangles in Ow hee county provide the explanation for larg quail concentrations there.

FOOD AND COVER—An important factor i quail survival is quality of protective cove During period of deep snows and intens cold, mountain quail descend to river bo toms to seek out dense briar thickets ab to withstand the crushing effect of snow an check the free movement of predator Along the Clearwater and Potlatch river the remaining blackberry tangles provi this type of shelter and protection. In thes thickets also dried, persistent fruits of th berry may be found, together with oth types of seeds which could not be trampl or eaten by grazing livestock earlier in th fall. Under the dense, strong brambles, th covey may huddle together for protectio from the cold. Quail eat fruits of suma hackberry and black locust in addition many varieties of grass and weed see



MERRIAM'S WILD TURKEY

Meleagris gallopavo merriami

Other name: Mountain Turkey

riam's turkey is a native American bird originally ting mountainous country in southwestern United It ancestral range is yellow pine and oak forest y from 6,000 to 10,000 feet or higher, of the inter- ain region from Central Colorado southward to exican border. It is a hardy strain.

l turkeys were first released by the Idaho Fish ame Department on the Salmon River Middle n the 1930's, but this attempt to establish the bird nsuccessful.

961, a shipment of 17 Merriam's wild turkeys from do was released in Idaho County on the breaks Salmon River in the Riggins-Whitebird area. es totaling 22 more birds were made in the same l area in 1962 and 1963.

February, 1965, the first in-state transplant of m wild turkeys was made. Ten birds were trapped iggins and released on Webb Creek in Nez Perce y. A continued winter transplant program will be ct until all possible turkey areas in the State een given trial releases.

ription: Wild turkeys are colorful birds, trim and appearance, with longer, thinner legs and more r body than the domestic form. Feathers of the neck and breast are black with a vivid coppery nished-bronze sheen, and marked with white on rump, and tip of tail.

sparsely covered skin of the head is dark with ingled black hairs and tiny feathers. Head skin s color from pink or purplish in breeding season to white or pale red. An appendage called the le dangles from the upper part of the forehead. eard" is a hairlike structure hanging from the east of the male bird; a small "beard" is also t on some female birds. Hens weight from 8 to nds; fat adult gobblers from 15 to 25 pounds.

and Young: Turkey hens may lay from a dozen ggs per clutch, with ten near the average. Laying starts early, often while snow remains in shaded areas and nights are cold. Incubation requires 28 days. Eggs resemble those of domestic birds in size and color. If the first nesting attempt is broken up, the hen will re-nest, much as pheasants do. Nests are often concealed in open areas away from trees and logs to avoid mammal predators.

The hen is a good mother, brooding the chicks in wet and cold weather. Young birds fly well at three weeks of age, and soon learn to take to the trees for protective cover. The hen provides watchful care over the brood during the training period. When an enemy is detected, an alarm note sends the flock into quick retreat and the birds disappear.

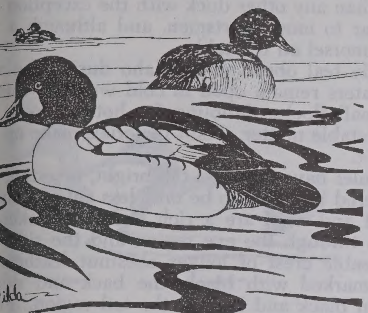
Turkeys can cover ground with speed and are topnotch uphill climbers. However, they are vulnerable to hot weather and seek a shady retreat when the sun is high. At dusk the flock assembles in favorite roost trees, usually bushy tall pines lacking lower limbs for added protection from three-climbing predators like the bobcat. Other predators on these birds include the coyote, golden eagle, skunks, racoons, dogs, squirrels, crows and magpies. But the wary wild turkey is very capable of taking care of itself and predation is seldom a serious source of population loss.

Foods: Turkeys will eat a variety of food, both animal and plant. Like other game birds, the young need a supply of insect food in addition to seeds and green plant material. As adults, they are largely grazers, consuming a broad variety of grass, leaves and seeds. Presence of mast-producing trees is not absolutely essential to Merriam turkey habitat, but this type food is a valuable asset. In Idaho, the birds seem to fare very well on the type of grasses, fruits, seeds and other foods associated with the yellow pine habitat.

The inherent wildness of the Merriam's turkey is an important factor in the survival of the species in our turkey ranges adjacent to Idaho ranchlands. In establishing wild turkeys, game managers desire a select strain able to forage and care for itself. "Ranchy" birds generally disappear from the range.

Game Birds of Idaho

BAY, SEA OR DIVING DUCKS



THE AMERICAN GOLDEN-EYE is a common winter visitor to Idaho waters, familiar to duck hunters as the "whistler" because of the characteristic whistle of its wings in flight. Good field marks are the low, straight course of the flocks up or down the stream channel, and contrasting black and white color pattern.

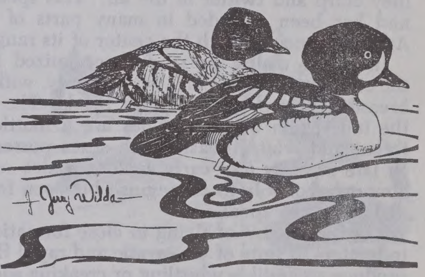
Male Golden-eyes have heads of dark iridescent green and the backs are velvety black against which the white wing coverts and speculum stand out. Rather long head feathers above a trim white neck give the girds a big-headed appearance. Males of this species have a circular white area on each side of the face near the bill. Females are smaller than males, with chocolate heads and subdued grey backs and sides. The bills are dark. The yellow amber eye gives the bird its name.

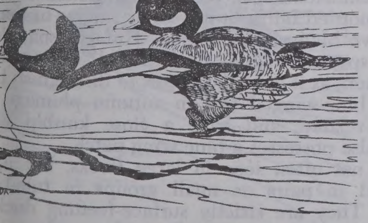
Golden-eyes may be seen in the winter season in loose rafts in expanses of open water or riding the turbulence of fast current in severe weather, diving to feed on available plant and animal matter near channel or lake bottom.

RROW'S GOLDEN-EYE is not as well known in this area as its n, the American Golden-eye. It is also a winter visitor, but is not ved as frequently as the American Golden-eye.

hief point of difference in the two species lies in the facial mark- The male Barrow's Golden-eye possesses a crescent shaped mark nt of the eye which makes its recognition positive. Also this es has less white on the sides and the scapulars are not marked as much white as the other Golden-eyes. The head has a purplish

ke other diving ducks, Golden-eyes disturbed near shore may nd swim toward open water before surfacing to take flight. A ng take off precedes the flight, and there is an audible pattering ngs and feet on the water surface before the birds get into the air. rrow's golden-eye is a strong diver and goes deep in search of n feed.





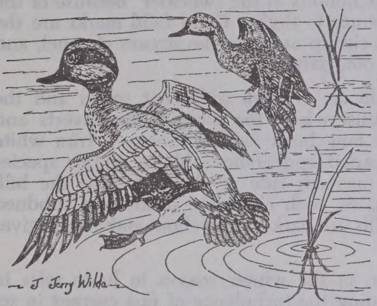
THE BUFFLE-HEAD is one of our smallest ducks, very trim and neat, and handsomely marked in the males. It is an expert diver and swimmer, and is a hardy species, sometimes called "butter-ball" by gunners because of the layers of fat beneath the skin, insulation against the cold water.

The black iridescent head feathers add to the beauty of the males of this species. The dark head, back and wings are marked by contrasting white areas. Females are paler with dusky, or ashen, feathers on head and back; with white cheek patches and light underparts. Feet of Buffle-heads are large for such small ducks, and match the dusky color of the bills.

Although pairs of this species are observed on lakes of northern and eastern Idaho until quite late in the spring, no authentic records of nesting have been recorded in this state. Small, wintering flocks are frequently seen in association with other diving ducks.

Game Birds of Idaho

SURFACE FEEDING DUCKS



THE GREEN-WINGED TEAL is our smallest duck. Dainty trim, it is an alert, fast flier, quick on the takeoff and believed to greater speed in the air than any other duck with the exception canvasback. It is familiar to most sportsmen, and although a elusive target, is a tasty morsel on the table.

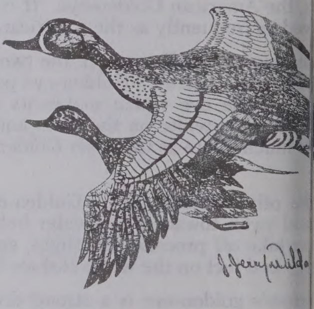
This species is the only teal observed in Idaho during the season. Where warm waters remain open in cold weather, this will feed and rest in small flocks, dabbling for bottom food, watercress and other vegetable matter. Plant materials make up ninety per cent of its diet.

By late October the males have taken on the bright, breeding age and then are considered by many to be only less colorful th wood duck itself. Head and neck are a rich chestnut broken brilliant splash of green through the eye region and the side head, and with a noticeable crest of longer chestnut feathers. chest is pinkish buffy marked with black, the back and sid grey, shading into brown black and buff in the tail region. Fe are grey-brown. The breast is white in both sexes and the fe bluish-grey.

THE BLUE-WINGED TEAL is almost as small as the greenwing, but the blue wing patch is a good identification mark as the compact flocks pass the observer. Like other teal the wingbeat is rapid, and they chirp and twitter in the air. This species visits Idaho regularly, and has been recorded in many parts of the state. It is a North American species, with the center of its range east of the Rockies.

In spring males are readily recognized by the white crescent on the side of the face. The head is grey, with some purplish gloss, the breast is brown, spotted with black. The back is grey-brown, and the tail region dark. Females are a mottled grey-brown, with pale throat and white breast. Both sexes possess the blue wing patches. In late summer and early autumn males resemble females, and it is almost impossible to distinguish between females of the blue-winged and cinnamon species.

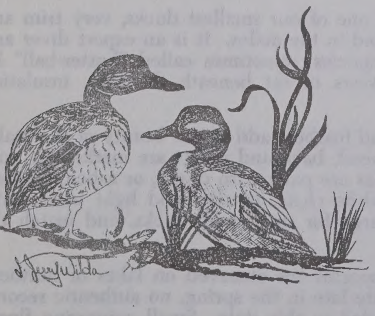
The teals' habit of flying in close formation makes them vulnerable to hunters in spite of the erratic and rapid flight. The swift wingbeats produce an audible whistling or creaking sound as the birds pass overhead. Like the cinnamon teal, the blue-wing is an early fall migrant, being classed as a warm weather duck.



THE CINNAMON TEAL is the only teal confined excl to Western North America, with the center of its abundance the Rocky Mountains. It is abundant in Idaho in spring and su but generally moves southward out of the state with the ar cold weather, as it is regarded as a warm weather duck.

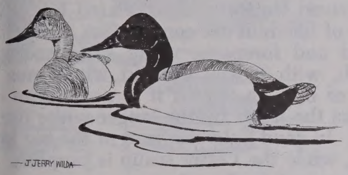
In spring and through the breeding season, males are conspi dressed in a rich, dark cinnamon coat, but with the summer mo plumage changes to a mottled buffy brown color similar to tha female. Both sexes have blue wing patches. Hunters someti roneously identify the species as "blue-winged teal" during th part of the hunting season, as it is very difficult to distinguish b female cinnamon and blue-winged teal in autumn plumage. two teals are closely related, and have a close kinship w shoveller duck, which also possesses a blue wing patch.

Cinnamon teals are not often seen in large flocks, but in generally are observed in pairs or small groups in tule-b sloughs and marshes. They are strictly surface-feeding duck species commonly nests in Idaho, principally in the southern i sections of the Snake River plains.



Game Birds of Idaho

BAY, SEA OR DIVING DUCKS



THE CANVASBACK is a large, conspicuously marked diving duck. Although not abundant here, this bird is seen in most sections of the state during migration periods, when the compact, wedge-shaped formations pass swiftly overhead or alight to mingle with other migrants in resting or feeding areas, generally in deeper water. Some of the birds remain in Idaho to nest.

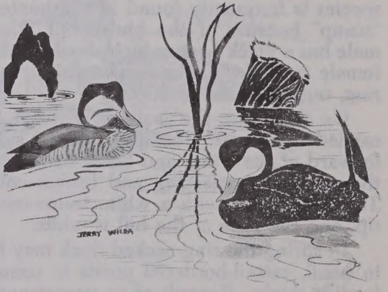
Male canvasbacks are distinguished by a dusky red head and neck, black foreparts and tail section, and white back, sides and underparts. In the air the long bill, dark, flat head and contrasting white midsection are good field marks. Females are similar in form and size, but are of a pale brown coloration. The canvasback is one of the most rapid fliers of all the ducks. It is exclusively a North American species.

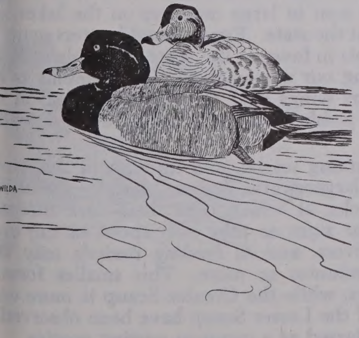
Like all the diving ducks the feet of the "Can" are large, and it runs for a distance over the surface of the water in the takeoff. It feeds mostly on submerged vegetation.

THE RUDDY DUCK is one of the smallest and most colorful of our ducks, and one of the most interesting. It is usually found in tches of open water, screened by the rushes or other marsh growth, d its odd appearance and bright colors demand attention.

The male in summer has a black crown, white cheeks and chin, d the chest, back and sides are a rich chestnut. The short, wide bill an unbelievable sky blue, and the black tail is carried stiffly erect, netimes tilted forward until it nearly touches the back of the head. males are a dull brown with white face markings and dark crown d tail. In fall and winter males resemble the females in color.

On land the ruddy duck is awkward, but in the water it is a pro- ient swimmer and diver, in this respect resembling the grebes with hich it is often associated. The ruddy duck is a common summer itor to most Idaho marshes.



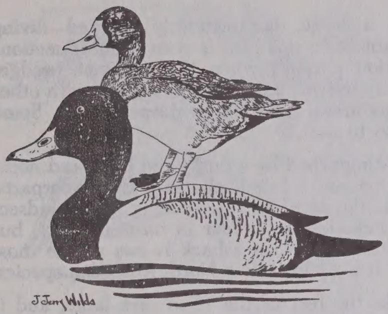


THE REDHEAD resembles the canvasback and they are frequently found in association. Like the canvasback, it is well distributed over Idaho, and nests here. The male of this species has a rich, chestnut head, black neck and gray back. The shorter, bluish bill, and domed, puffy head, distinguish the redhead from the canvasback. Females are brown-backed, white-breasted birds, darker in color than the female canvasback.

An accomplished diver, the redhead feeds largely on water plants. Practically all its food is vegetation. It is a bird of the more open waters, and is often seen in the company of scaups and ringnecked ducks. Like the canvasback, the redhead builds its nest over water, usually in clumps or masses of reeds and rushes.

Game Birds of Idaho

BAY, SEA OR DIVING DUCKS



THE GREATER SCAUP, OR BIG BLUEBILL, is a migrant to Idah waters in spring and fall. Although not as common here as the Less Scaup, small rafts of these divers may be seen on our larger lake or taken from migrant flocks by gunners along the open river course The birds are rapid fliers, and in some states "broadbill" shooting rated high as a sport.

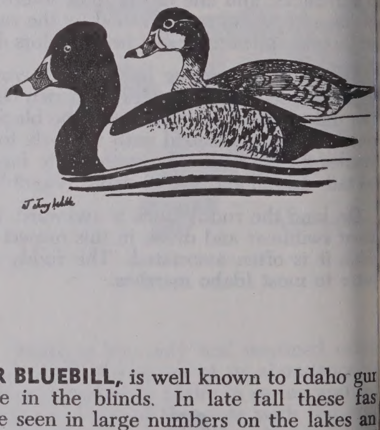
The name "bluebill" is derived from the short, flared bill whic has a chalky blue color. Rafts of bluebills are conspicuous and readil recognized by the dark head and foreparts, white sides and gre backs. Females are brownish, with a well defined white area o forehead and cheeks at base of bill. In the air it is possible to di tinguish the greater scaup from the lesser by the longer white bar o the upper surface of the wing. In good light the head of the big bluebill has a greenish iridescence, while the Lesser scaup is purplish.

Scaups are proficient divers, and feed on bottom vegetation an animal matter, going down as deep as twenty feet to secure this foo When the rafts are disturbed, flocks churn the water for a considerabl distance in a running takeoff.

THE RING-NECKED DUCK is a diving duck relatively unknown to Idaho gunners, in spite of the fact that it is a common migrant across the state. Experienced observers report them more abundant here in spring migration than during the hunting season, but the species is frequently found in the hunters' bags, generally misnamed "scaup" because of the bluish bill. Unlike scaups, the ring-necked male has a black back, which should make identification positive. The female is similar to the female scaup, but has a noticeable white eye ring, not possessed by scaups.

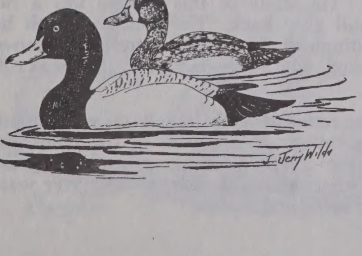
On the water the male ringnecked duck has a dark, puffy head carried well erect. The light-colored sides, vertical white wedge just forward of the wing, and black back are distinctive. The female has the white face marking and brown coloration of the scaup female. The bill is blue with a white transverse band just behind the black tip, and the base of the bill is white.

In spring the ring-necked duck may be seen swimming and diving in small, cattail-bordered ponds in company with coots and surface-feeding ducks. Records of its occurrence as a breeding duck in Idaho are rare.

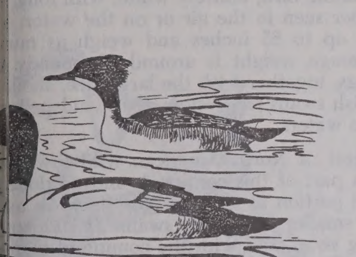


THE LESSER SCAUP, OR BLUEBILL, is well known to Idaho gunners who spend much time in the blinds. In late fall these fas chunky-bodied fliers may be seen in large numbers on the lakes an main water courses throughout the state. Experienced hunters genera ly pass these bullet-like targents in favor of the more palatable mallar widgeon or pintail, but during our season the kill of bluebills is appreciable. In the air the short wings beat at high speed, and in th landing approach the broad webbed feet are thrust forward with braking action.

Toward the end of the hunting season, and throughout the winte if frost does not seal up the larger water bodies, bluebills are one our commoner wintering ducks, at which time their dark forepart and grey backs are a familiar sight as they bob about in the ope water. Scaups are strong divers, and in feeding periods may sta below the surface for two minutes or more. This smaller form known to prefer inland waters, while the Greater Scaup is more common along the coast. Nests of the Lesser Scaup have been observed i Idaho. At Gray's Lake it is classed as a common nesting species.



Game Birds of Idaho



AMERICAN MERGANSER Unlike the other ducks characterized by the broad, flattened bill, the fish-eating ducks possess a specialized bill for catching and holding its prey, a slender bill armed with toothed edges. Feet of mergansers are large, and the birds are strong swimmers and capable divers.

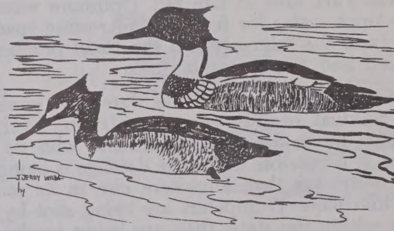
During Idaho winters these strong handsome ducks may be observed in waters too turbulent to freeze, resting on the ice floes at the edges of the current or bobbing like corks in the white water. Occasionally the birds will flash out of sight to reappear with a wriggling fish clamped in the toothed mandibles. A quick movement of the head accompanies the act of swallowing, as the minnow disappears headfirst down the fish duck's gullet.

In winter and spring male birds of this species appear as strongly marked black and white birds, the white of the breast suffused with salmon pink, and the head a greenish black. Feet and bill are orange. Females are gray with a crested red head and a large square white patch on the wing.

EASTED MERGANSER At the height of the spring mi-
ervers may find this colorful red-breasted merganser
ther waterfowl in Idaho's ponds and marshes. At this sea-
sted heads of the males are a greenish black and the
wn striped breast makes these birds stand out. Females
ith crested reddish head and white wing patch similar to
female American merganser. In early fall the males are
e plumage and at that season resemble the females.

ers in flight have a slim, drawn-out appearance, as the
ad and neck are carried in a straight line ahead of the
together with the square white wing patches, makes them
nizable in the air.

t of mergansers makes the flesh unpalatable, and ex-
unners generally select other ducks over the blinds. It is
o what extent the feeding habits of these birds is injurious
populations, but it is likely that most of the fish taken
e numerous trash fish varieties.

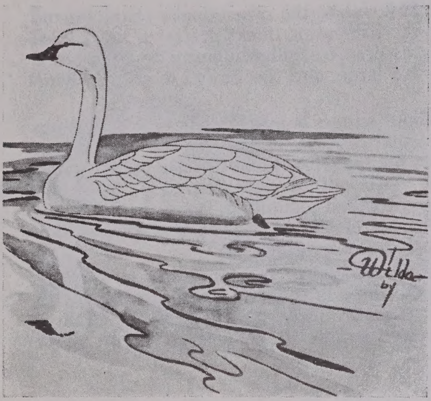


HOODED MERGANSER The smallest of our mergansers, this bird is most strikingly marked. The males in breeding plumage are distinguished by a high, rounded crest of velvety black feathers in which is inserted a large, conspicuous wedge of white. The dark head and neck have iridescent glints, and plume-like wing coverts of black and white set off the dark back. The sides are brown, penciled with fine dar klines. Breast and under parts are white. The females are a subdued brownish color, with chestnut crest and head. These medium-sized ducks are neat and trim, and in their choice of habitat resemble wood ducks.

Hooded mergansers nest in cavities in trees and stumps, and in summer the broods are seen in streams and lakes in the wooded parts of Idaho. Like the other mergansers these birds feed upon fish to a large extent, and they possess the characteristic narrow, toothed mandibles. In migration season small flocks of a dozen or more birds may be seen in wooded bays of our northern Idaho lakes, and south Idaho gunners occasionally take them from flights along the Snake and other streams. This bird apparently is not as abundant in Idaho as its larger cousins.

Game Birds of Idaho

THE SWANS

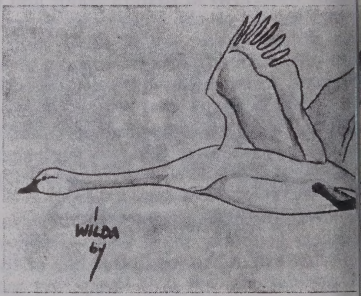


Trumpeter Swan is the larger of the two swan species Idaho each year. It is a noble bird, entirely white, with long graceful carriage, whether seen in the air or on the water. I this species may attain up to 65 inches and weigh as muc pounds, though the average weight is around 20 pounds. of any black on the wings, together with the large size, shoul the observer to distinguish swans from snow geese and pelica of which occur on Idaho waters.

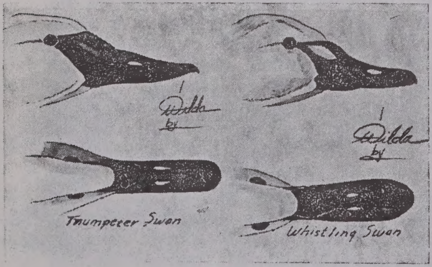
The Trumpeter, largest of North American wild fowl, o abundant in the western part of this continent, and no doub over most of the eastern portion as well, in vast flocks in as with the flights of the smaller Whistling swans. It did not far north as the whistling swan, and with the coming of man size made it vulnerable. Gradually its numbers declined unt 1920's there were fewer than fifty individual birds of th Rigorous closure of hunting seasons on swans everywhere country undoubtedly prevented the Trumpeter's exterminat the last two decades the birds have made a fair comeback are now approximately 1,500 Trumpeters in existence. Of this about 550 are in the U. S., in Montana, Idaho and the Yell Park, with the remainder counted in British Columbia and

Idaho's upper Snake River today is wintering most of the Trumpeters occurring within the United States. These birds move into the Island Park area in late fall. Optimum water temperatures here provide open water for feeding and resting space during the winter months, and the migrants join the small number of birds that have summered and nested within Idaho.

This is the reason our Idaho waterfowl hunters are so important to the survival of this swan population. Every fall a number of Trumpeter swans are shot by hunters who do not understand the problem. It is possible that more damage is being done to this species on Idaho flyways than anywhere else in its range. It is reasonably certain that more Trumpeters are being shot by careless or ignorant gunners within the state, than are being produced by the few pairs that have adopted Idaho for a breeding range. The Island Park region of the upper Snake river drainage is the only place in Idaho where Trumpeters nest.



The voice of our native swans is musical and resonant, on most inspiring sounds in nature. The sound is difficult to and must be heard in the swan's habitat to be appreciated fu rich, complex quality of tone is believed due to a coiled loo windpipe within a hollow breastbone which gives the birds vocal power.

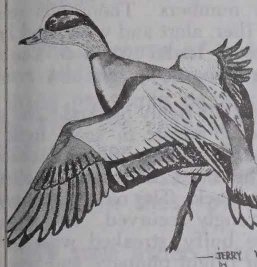


Whistling Swan is the swan usually seen in flocks dur season of migration in spring and fall in many parts of the sta somewhat smaller than the Trumpeter, in weight up to 18 and with length of about 50 inches. Like the Trumpeter it is al Habits and flight characteristics are similar.

Swans prefer to feed far out in open water where they ca down and pull up submerged vegetation. They are wary of marshes where border vegetation may conceal an enemy. W swans do not nest in Idaho, but in spring congregate in rafts o lakes and along the larger streams, where they rest and fee time before passing on across Canada to their arctic nesting

Game Birds of Idaho

SURFACE FEEDING DUCKS


JERRY WILDA—

The AMERICAN WIDGEON, or BALDPATE, is abundant in Idaho. An alert, nervous duck, it is usually the first to take to the air when an intruder approaches the resting or feeding area. Flocks in flight may be distinguished by the piping notes uttered by the males. Of medium size, the birds are quick on the wing.

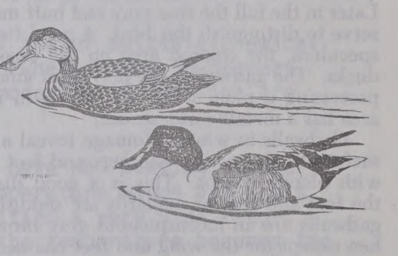
The baldpate derives its name from the white forehead and crown of the males. In early fall this crown area contains a generous flecking of dark feathers, but with completion of the molt the bright winter plumage is acquired. Then the brilliant green splash through the eye, white flanks and pinkish brown of chest and breast make the widgeon male a handsome bird. Females are brownish, with gray head and neck. The belly and forepart of the wing are white in both sexes. The bill is blue, with a black tip.

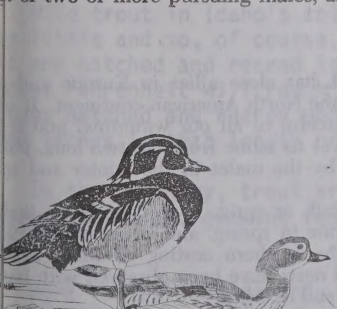
Widgeons sit high in the water and pivot quickly as they feed. Most food taken is vegetable matter, with some snails and insects also eaten. In late winter and early spring they may be observed grazing on grass and other tender plant parts, in the manner of geese.

The SHOVELER, or SPOONBILL occurs throughout the state, is easily recognized by the large, spoon-shaped bill. A medium-d duck, males in spring are identified by a dark green head, con-ious white chest and foreback, chestnut sides and dark under-s. In the fall the males resemble the females, a plain brown color. sexes possess a blue wing patch similar to those of the blue-ed and cinnamon teal.

he spoonbill is considered a warm weather duck, and arrives in o on the northward migration when spring is well advanced. of all ducks are provided with a fringe of comb-like teeth along edges of the mandibles. In the case of the shoveler, these are long well-developed, enabling the duck to strain out quantities of le plant and insect materials from the water and bottom ooze.

he shoveler is a strong flier and like other surface feeders is able y vertically from the water in a bounding takeoff when alerted. tial flights, in which a single female may be observed leading a t of two or more pursuing males, are fast and erratic.



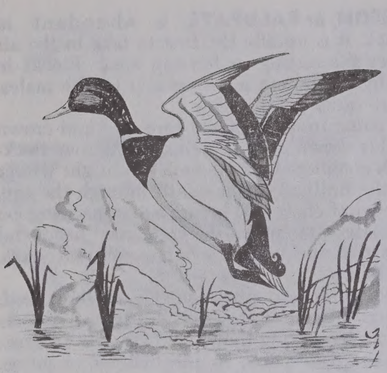


The WOOD DUCK is the most colorful waterfowl species in Idaho. The male has a green head, irridescent with glints of blue, purple and red in sunlight, and the dark pattern is broken by a white line along the crest and behind the eye, and by white areas in the region of neck and throat. The eye and bill are reddish, and the chest is a purple chestnut, spotted with white. The back is green, and the sides and flanks are buffy and chestnut, marked with white. The female wood duck is pale, ashy brown, with dark bill and conspicuous white eye ring and throat area.

For a number of years prior to 1941 the wood duck was given complete protection in the western states, but since that year the Idaho gunner has been allowed one of these birds in the bag. It is a strictly North American species. Keen observers can distinguish it from more common ducks as it flies past with head held above the line of the rest of the body, with the bill pointed downward at a sharp angle. Each year broods of young wood ducks are observed in Idaho's Panhandle.

Game Birds of Idaho

SURFACE FEEDING DUCKS



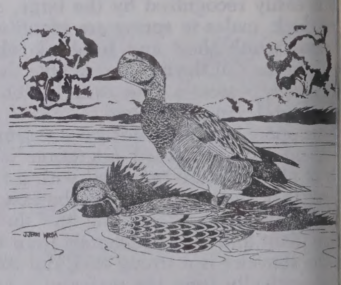
THE MALLARD DUCK is the favorite of Idaho duck hunters, is the most abundant wild duck occurring within the state. It is fou here at all seasons, nesting in large numbers. Thousands rem throughout the winter, as it is a strong flier, alert and wary, and ha enough to withstand well the extremes of Idaho weather. The w mallard is the progenitor of most of our domestic species.

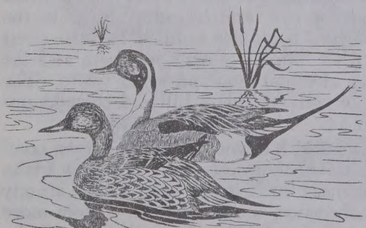
In winter and spring the mallard drake is richly marked. The h and upper neck are an iridescent green, purple in some lights. narrow white collar separates the green head from the rich chest of the breast. The back is brown, the sides, flanks and belly grayish white, and the tail coverts are black. The outer tail feath are white, and the central ones are strongly recurved. The legs feet are reddish orange. Females are buffy, streaked with bro During the summer the males lose their bright plumage and resem the females. While moulting the powers of flight are lost and ducks remain in concealment until new flight feathers develop.

THE GADWALL or gray duck, although not abundant in Idaho appears frequently in the hunter's bag here. In early fall this duck is sometimes mistaken for the mallard hen, despite its smaller size. Later in the fall the fine gray and buff markings of the winter plumage serve to distinguish this bird. A good field mark is the all-white wing speculum, the colored area on the secondary wing feathers in most ducks. The gadwall is the only duck among the surface feeding group possessing a plain white speculum; in most of the other ducks this area has a metallic iridescence.

Gadwalls in winter plumage reveal a chestnut patch on the upper surface of the wing. The legs and feet of these birds are yellowish, with blackish webs. This is a good distinguishing characteristic, as the feet and legs of mallards are reddish orange in contrast. Female gadwalls are an inconspicuous gray brown, and resemble the mallard hen except for the wing and feet characteristics described.

Although the gadwall generally feeds by dabbling at the surface, it is one of the few surface-feeding ducks that will dive for food when necessary.





THE AMERICAN PINTAIL has close allies in Europe and A but this variety is confined to the North American continent. It is of the most handsome and graceful of all our waterfowl and is w known all over Idaho. It derives its name from the two long, poin central tailfeathers possessed by the males in the winter and spr plumage.

An early migrant, the pintail, or sprig, is seen in Idaho in la flocks before the snows are gone in spring, and is one of the first cross Idaho in the fall from the northern nesting grounds. Many the birds nest in the state, and nests have been observed with incu tion well advanced before the end of April.

The long tail and elongate neck give this duck a trim, streamli appearance, and also make it appear larger and faster than it really In breeding plumage the male has a dark brown head glossed w greenish, while the white of the forebreast passes up along each of the neck in a narrowing white line that reaches almost to the b of the eye. General coloration of the back and sides is gray, mar with black and white.

FISH CULTURE IN IDAHO

The Idaho Fish and Game Department operates seventeen fisheries installations,
luding fish hatcheries, spawn-taking and distribution stations. They are located
American Falls, Ashton, Clarks Fork, Eagle, Fernwood, Grace, Hagerman, Hayspur,
rys Lake, Kamiah, Mackay, McCall, Mullan, Sandpoint, Twin Falls, Warm River, and
f Lodge.

The purpose of this program is to improve fishing in Idaho. In some areas this
ns adding extra fish to waters where natural reproduction cannot keep up with the
hing pressure because of poor wintering or growing conditions. Here, the legal-
e fish are released, ready for the fisherman to catch during that same season.
hout these extra fish, the early fisherman would soon take most of the wild trout,
ving only disappointment for people coming later that year. Release of legal-
e fish in these places keeps fishing good all season.

In some other waters where spawning conditions are poor, but growing conditions
very good, the Department releases little fish as they are needed. These fish
v up and add to the fishing pleasure of many people over the state.

Most of the fish raised in Idaho fish hatcheries are rainbow trout because this
cies is a favorite with fishermen, does well in so many Idaho lakes and streams,
is easier to raise than most other trout species. However, the Department also
thes and raises cutthroat, brook, and golden trout and kokanee salmon.

For a successful hatchery, the water must be plentiful and of suitable chemical
ity, and it must keep a fairly constant temperature somewhere about 55 degrees
renheit. Also, weather conditions in the area must be moderate if the fish are
grow fast and keep in good condition.

It is a peculiarity of cold-blooded animals that they have no "heating system"
their bodies as warm-blooded animals do. Their body temperature warms and cools
h the temperature around them, and most of them cannot stand a very wide range
temperature. They become inactive or many even die if the temperature becomes too
or too cold.

Wild trout in Idaho's cold mountain streams become dormant in winter. They eat
y little and so, of course, they also grow very little. For this reason, trout
t are hatched and reared in hatcheries with water temperatures between 50 to 60
rees Fahrenheit will reach legal size in a year, but trout from the same batch
ggs hatched and reared under less favorable conditions may grow only two or
e inches in that length of time.

In the hatchery, trout are fed a scientifically formulated diet to keep them
good health and growing fast in spite of the artificial conditions under which
y live.

Work varies considerably at the 17 fisheries stations. The primary functions
particular installation include one or more activities such as hatching, rearing,
wn-taking, or simply holding ponds.

The main purpose of the holding ponds is to serve as distributing stations. To
se places the big highway transports bring shipments of fish ready for release, and
oad them into holding ponds. Then smaller trucks take the fish to the designated
eams or lakes and release them.

GROWTH OF FISHES

By John T. Heimer
Fisheries Biologist

Growth of fishes has been studied extensively in Idaho as well as in other states. This research gives us information necessary to:

- Compare the rate of fish growth in different bodies of water.
- Determine how long it will take fish of a given species to reach catchable size.
- Determine the age and size at which a fish will attain sexual maturity.

Factors In The Environment

Many things combine to determine how fast a fish will grow. Three of the most important factors are: food supply, temperature, and genetics.

The food supply is usually determined by the environment in which the fish grows. A fish living in a productive stream, or lake, will grow much faster than the same fish in less productive waters. An example of this is the Richfield Canal in south-central Idaho. Rainbow trout in these waters show tremendous growth during the summer months because of numerous scuds (fresh water shrimp) which are utilized as food.

Fish with a wide latitudinal distribution commonly have differences in their rate of growth in northern versus southern waters. A classical example of this is the largemouth bass. In the northern United States largemouth bass grow much slower than their southern cousins. The reason is that the cooler water temperatures in the northern regions slows down the metabolic processes for converting food into fish flesh.

Parental factors influence the growth of trout. The progeny of large, fast-growing fish are usually faster growing and larger than the progeny of smaller, slower-growing fish. Kamloops and mackinaw grow to a large size because they have inherited this growth from their parents.

Continuous Growth

Fishes are poikilothermous (cold blooded) and for most of them growth is a continuous process. As soon as a young fish hatches it starts a period of growth that may continue for the rest of its life. However, the specific growth rate may fluctuate and on the average declines as the fish gets older.

At some stage the fish becomes sexually mature and spawns, and may spawn at regular intervals for the rest of its life. Between spawning periods the fish may continue to grow until it eventually dies. Thus there may be a considerable range in size between sexually mature fish of the same species.

An interesting contrast between the growth patterns of mammals and fishes should be pointed out. An adult mammal is continually in danger of competition from younger, stronger adults of the same species, whereas a fish as it grows older is progressively in less danger from younger, smaller "adults."

Although many fish continue to grow after reaching sexual maturity, this event usually marks a change in growth patterns. The average growth rates of mature fish are generally lower than those of immature fish of the same age. This is because a considerable amount of food intake is transformed into sperm and ova, instead of muscle and bone. Some fish breed frequently at short intervals of time and may cease to grow as soon as they become sexually mature. Tropical fish commonly have this "mammalian" type of growth pattern because their breeding activities are not dependent upon environmental factors which vary in an annual cycle.

Size Differences

Frequently there are size differences between mature male and female fish of the same age within a species. The size differences between the sexes may be due to genetic factors. It has also been correlated with inherited behavior patterns. It is thought that reproductive habits such as nest building affects the size differences between the sexes. The greatest size appears most often to be associated with the most dominant parent.

One growth factor that has been observed among fish is the "peck order" or order of dominance. The individual fish at the top of this order will regularly secure the most food. This is most often observed under crowded conditions.

It is unknown whether growth differences due to "peck order" resu from increased food intake of t dominant individual or from psych logical stresses placed on the small members of the group. It appea that the growth rate of an individu fish is influenced by group size well as by the numbers of larger a smaller fish present.

The most pronounced group effe on growth is found in crowded fi populations. Here growth is thoug to be influenced by the food supp rather than the stresses found in t group.

Fish quickly become stunted wh they become so numerous that th growth rate is reduced. When som of the stunted fish are removed t remainder responds to the new cond tions and their growth rate increas

Diet

In most instances fish eat eith plant or animal life. Some live on o particular plant or animal while ot ers eat many different kinds.

Normal fish spend part of th lives resting and part in activity. Th degree of activity is influenced chie by temperature. The energy for th activity must be obtained from foo Fish can gain weight only if they e more food than is necessary to satis their basal metabolism and to provi energy for their activity.

The amount of food which a fi must eat if it is neither to gain nor lose weight is the "maintenance quirement." This provides for routi metabolism. This metabolism w vary with environmental factors a may vary with the size, and age the fish.

The type of available food m be especially important at certa times in the life of a fish. Many f change their habits as they gr older. A change of diet may also cur with this change of habit.

Generally, the larger fish in strea and lakes are those individuals wh have adapted to a fish-eating ha Individuals of comparable age size are not found in waters wh there are no suitable fish to act food. When fish move into wat with a more abundant food suppl pronounced increase in growth often occurs. ◆ ◆ ◆

Idaho
Record Fish

TROUT

Mackinaw—
54 pounds 5 ounces. Caught by Russ Herman, Spokane, Wash., from Priest Lake, April, 1964. Length, 44"; girth, 34".

Kamloops—
37 pounds. Caught by Wes Hamlet at Pend Oreille Lake, 1947.

Rainbow—
19 pounds. Caught by R. M. Williams, Hayden Lake, Nov., 1947.

Steelhead—
29 pounds 8 ounces. Caught by Leonard Profitt from North Fork Clearwater River 4 miles west of Orofino, Dec., 1966.

Cutthroat—
18 pounds, 15 ounces. Caught by Roger Grunig, Montpelier, in Bear Lake, April 30, 1970.

Cutthroat-Rainbow (hybrid)—
23 pounds 4 ounces. Caught by Phil Adderly, Blackfoot Reservoir, 1957.

Brook—
6 pounds 10 ounces. Caught by Donald Kotschevar, Deep Creek Reservoir, 1958.

Brown—
25 pounds 12 ounces. Caught by Jim McMurtrey, Ririe, at Palisades Reservoir, March 23, 1969. Length, 37½"; girth, 22½".

Dolly Varden—
32 pounds. Caught by Nelson Higgins, Pend Oreille Lake, 1949.

Golden—
5 pounds 2 ounces. Caught by George Wolverton, White Sands Lake, 1958.

SALMON

Chinook—
45 pounds. Caught by Hurbert Staggie, Idaho Falls, from Salmon River, near mouth of Pahsimeroi River, Sept. 5, 1964.

Kokanee—
3 pounds 10 ounces. Caught by Ted Miller at Moose Creek (Island Park) Sept., 1958.

Sockeye—
4 pounds. Caught by Marc Wride at Redfish Lake, 1957.

OTHERS

Sturgeon (Rod and Reel)—
394 pounds. Caught by Glen Howard from Snake River near Swan Falls, 1956.

Sturgeon (Set Line)
675 pounds. Unknown; at Shoshone Falls, Snake River, 1908.

Largemouth Bass—
10 pounds 15 ounces. Caught by Mrs. M. W. Taylor, Anderson Lake near Harrison. Year unknown.

Smallmouth Bass—
5 pounds 14 ounces. Caught by B. B. Bacharach, Lewiston, from the Snake River, May, 1962.

Channel Catfish—
21 pounds, 8 ounces. Caught by Gary E. Kluksdal, Boise, Snake River below Nyssa bridge, March 27, 1970.

Bullhead Catfish—
2 pounds 9 ounces. Caught by Charles Carpenter, Rt. 1, New Plymouth, May 13, 1967. Farm Pond in Payette County.

Flathead Catfish—
25 pounds, 34 inches long. Caught by Bill Branstrom, Lewiston, Snake River above Lewiston, May 17, 1970.

Perch—
2 pounds 8 ounces. Caught at Murtaugh Reservoir by Dewey Julian, Twin Falls.

Crappie—
2 pounds 8 ounces. Caught by Mrs. Carl Tifft at Shepherd Lake, 1954.

Whitefish (Mountain)—
5 pounds 4 ounces. Caught at South Fork Payette River, 1941.

Bluegill—
3 pounds 8 ounces. Caught by Darrell Grim, Nampa, from C. J. Strike Reservoir, May, 1966.

Ling—
14 pounds. Caught by P. A. Dayton from Kootenai River near Copeland, 1954.

About every two years we re-publish the list of Idaho record fish making necessary changes as larger fish are caught. These are official weights as of May, 30, 1970. The Editor

THE ENVIRONMENTAL WEB

The following section deals with the basic make-up of the Environment:

- Biomes
- Environmental Factors

Biomes

Concept Regional climates interact with regional biota and substrate to produce large easily recognizable community units called biomes.

Purpose of Lesson To help students understand that physical features such as temperature, altitude, and moisture interacting with soil and water of an area produce world communities called *biomes*, each with its characteristic life.

Introducing the Concept Before taking the students on a field trip, the following film is recommended as an introduction to biomes: *Plant–Animal Communities—The Physical Environment*. The various physical conditions of several different environments are described with the effects these conditions have on plant and animal communities. A deciduous forest and mountain, coniferous forest, grassland, and desert environments are shown.

Developing the Concept Field trip:

Students are taken on a field trip to different communities such as a stream, a swamp, a pasture, and a forest. Here they note the differences in various physical limiting factors. In the field students are asked to note the following for each community visited:

1 Plant life—types
2 Animal life
3 Temperature
4 Soil—nature of
5 Effects of wind
6 Exposure
7 Moisture
8 Characteristics of total area

The above may be brought to the student's attention through questions or, if time permits, determined experimentally. Other distinguishing characteristics of the area may be considered. The above are but a few possibilities.

Extending the Concept Class Discussion:

1 How did the plant life differ from one community to another? Why? What factors in the environment determine the growth of the plants noted?
2 Compare the animals found in each community. Why did they choose their respective habitat?
3 Was the forest cooler than the pasture? Why? Why not?
4 Which soil contained the most humus? Where was more erosion evident? Why was it most noticeable in that area?
5 How does the availability of water determine plant growth?
6 How do temperature and moisture acting together determine the climate?

7 What effect did the wind have on local areas?
8 Study maps of biomes of the world. Try to account for the characteristics of the major biomes of the world.
9 As outside assignment or class assignment, have individuals or groups choose a biome to study characteristics, plants, animals, climate, and show how these are associated with the biome.
10 Have reports on results given to the class. Use large map to show biomes as reports are being given.

Fixing the Concept

Ask:

1 How does the interaction of moisture and temperature help to determine the makeup of a community?
2 What are some of the major world biomes?
3 How does altitude affect biomes?
4 What are the biomes of your local area?
5 What is the significance of a biome? Why should one have an understanding of world communities?
6 What principles of soil, water, forest, and wildlife conservation do you learn from the study of biomes?

Suggested Projects:

1 Study of local biotic community.
2 Riches in community.
3 Sampling of plant and animal populations of the community.

Environmental Factors

Concept There are various physical factors of the environment which limit and help to determine the types of organisms living there.

Purpose of Lesson To help students understand the physical factors of the environment which help to determine the life of a given area. (This lesson should be taught before plant succession is studied.)

Introducing the Concept It is assumed students have briefly reviewed such physical limiting factors as water, light, soil, temperature, etc. They realize that there are certain factors of the enviroment which make a community what it is. These factors can be taught more adequately by taking students into the field and allowing them to investigate and see these factors.

First Field Trip: Visit an area with a slope or hill which has a noticeable difference in elevation. In an area without hills, you may use several different communities such as a field, swamp, or wooded area. The students are divided into groups and select a recorder to take notes for the group. This field trip involves determining the different communities and driving stakes to identify and label (by numbers) each community. As each community is determined, students should drive stakes to mark each area for future reference.

1 At the start of the trip, at the top of the hill ask students what type of plants they see. (Give names, if possible.) What is the nature of the undergrowth? (Give names, if possible.) Are there a great many low-growing plants? Why? Why not? Note as many characteristics of the area as possible. Pick up a handful of soil and note moisture and type. Note depth of decaying leaves on forest floor.

2 As you move to another area, let students help decide when you are in another environment and ask why? How can you tell? (Should be about middle of slope but you should not tell them—must guide them into finding answers and seeing what you want to teach.)

Ask about:

- a Trees
- b If on windward side, the effects of the wind on the vegetation
- c Major or any differences between two areas
- d Types of plants
- e Undergrowth
- f Understory

3 Proceed to the very bottom of the slope, which should be quite different in physical appearance. Here ask questions of the same type as used in other areas, and note as many differences as possible.

Developing the Concept Laboratory:

1 In lab have students discuss notes made in the field and compile for each community (staked area) a list of the factors of the environment which might influence the plant growth for that area. Combine factors to form one complete list. On one board have students com-

pare lists; perhaps they disagree with you. (You might encourage disagreement. Then say, well how can we prove who is right? Set up investigations.)

2 Let individuals or groups choose factor for which they want to test. (The number per group will be determined by the number of students and the number of factors. As many factors as time and equipment allow may be measured.)

For information on limiting factors consult Odum, E.P.: *Fundamentals of Ecology.*

Second Field Trip: This field trip cannot be completed in one day, but may require as long as a week to complete results. It should be set up at this time (with aid of teacher) and each group should have time to determine results.

In the field, each group chooses the appropriate place and sets up the specific experiment for measuring the limiting factor with which he is dealing. The preparation will require several hours or longer and the teacher's guidance will be necessary.

Laboratory Class: When field experiments have run to completion, calculate and compile results. Here again the teacher's guidance will be essential in helping to compile results. (This phase of the lesson is most important.)

A definite relationship between the limiting factors and the characteristics of each community should be established. Each group should compile relationships from results, and in class discussion all relationships should be established. The greatest value of these lessons is to show these relationships.

Extending the Concept Third Field Trip: This trip should be to an entirely different area, but should show communities which are unlike each other. Pupils should be able to see the results of many limiting factors.

Walk through area and:

1 Discuss different communities.
2 Identify as many plants as possible in each area and account for growth there.
3 Point out limiting factors for plants in each area.
4 What might be the nature of a given community if a factor such as fire had been present?
5 Predict the type of community that might have developed if certain physical limiting factors had been included or omitted.

Class Discussion: After the third field trip students should make comparisons of limiting factors not found in both areas and try to determine their effects on the given community.

At this time pupils should culminate and integrate the concept of limiting factors as related to communities. Emphasis should be placed on the values of conserving natural resources through the proper control and management of limiting factors.

Fixing the Concept A discussion of the following is recommended after all field work and labs to fix the concept for each student.

1 What effect does a limiting factor, such as temperature, have upon a given area?

2 What area of a slope receives greatest exposure?
3 How does exposure affect the plants of an area? What type of plants are most likely to grow in an area of greatest exposure?
4 What determines the water-holding capacity of the soil?
5 Why is the rate of evaporation as important as the amount of available water?
6 Why are temperature and moisture acting together the most important parts of climate?
7 Why is relative humidity a limiting factor?
8 What effect does wind have upon:
    a Rate of evaporation?
    b Plants on the windward side of a hill?
    c Temperature?
9 What effect does vegetation have upon the temperature of an area?
10 Will more energy be absorbed by a forest or a bare field? Why?
11 What type of soil has the greatest water-holding capacity?
12 What zone of the soil contains the most humus?
13 Why can we consider fire a limiting factor?
14 Which community had soil with the greatest amount of humus?
15 Which community contained soil with the highest pH?
16 What limiting factor determines the biomes of the world?

From a discussion of the above questions students should be able to relate these ideas to many principles of conservation in the home, community, school, state, and nation.

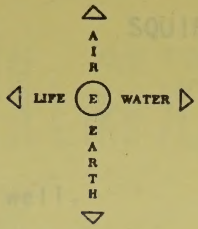
PROJECT CARDS

Project cards are a new concept in Environmental Teaching with the goal of encouraging environmental consciousness. They are based on the fact that students "learn by doing - not by telling." The cards use a multi-disciplinary approach.

Age levels are not suggested as every grade level can answer the chosen card at their level, answers differing only in their sophistication. By this method, a student is encouraged to inquire, explore and discover on his own.

The following project cards are provided to give the teacher ideas for her own cards. Ideally, they can be used to show the students how to make up their own project cards.

10-2



EARTH

© Lander Conservation Center 1972

(E)

EARTH

INDEX

1. Here to There
2. Squirt
3. Crystal Clear
4. Get Involved
5. Up the Narrow Stairway
6. Our Town
7. Careers
8. Cavernous Creation
9. Up and Down
10. Down in the Dumps
11. Sell It
12. Blow Hard
13. Ups and Downs
14. Give Tomorrow a Chance
15. Peek Under a Rock
15a Berlese Funnel
15b Catch a Nematode
16. Take a Look
16a Soil Testing
17. Still
18. Mineral Pudding
19. Building Blocks
20. In The Beginning
21. Hard Rock
22. Cave in
23. Whose Fault
24. Fountain Service
25. Rare Earth
26. Color Me Dirty
27. Look Around Your Ground

(E)

EARTH

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28. Wanted
29. Search Out
30. Clean-up Campaign
31. Picture Me
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33. Adoption
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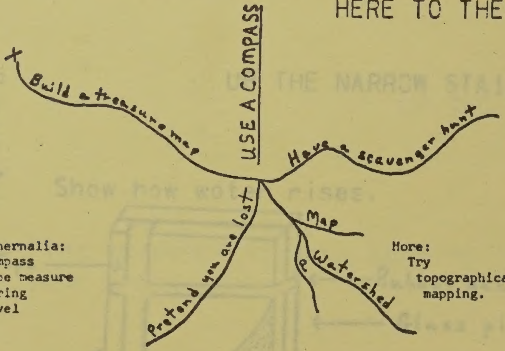
35. Dirty Book
36. Waterhole # 1
37. Waterhole # 2
38. Water Hold
38a Water Hold - Reference
39 hydroponics
39a hydroponics - Reference
40. Earthquake
41. How Salty I Am
42. Wash Out
43. Tracer
44. Food for Thought
44a Soil Profile
45. Rock Talk
45a Stone Hardness Chart
46. The Association
47. Latitude Attitude
48. Angling

(E)

EARTH

Maps

HERE TO THERE



Paraphernalia:
Compass
Tape measure
String
Level

More:
Try topographical mapping.

Goal 6

SQUIRT 2

(E)
EARTH

Make an artesian well.

Goal 3

CRYSTAL CLEAR 3

(E)
EARTH

I BEG YOUR PARDON
— GROW A CRYSTAL GARDEN

Dish
Non-iodized Salt
Bluing
Food Coloring
Charcoal Briquette
Ammonia
Water

Goal 3

GET INVOLVED 4

(E)
EARTH

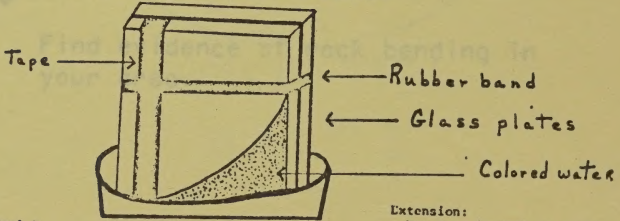
RECYCLE SOME JUNK

Goal 5

UP THE NARROW STAIRWAY 5

(E)
EARTH

Show how water rises.


Tape
Rubber band
Glass plates
Colored water

Extension:
How does it work in soil?

Goal 4

(E)

E A R T H ↓

OUR TOWN 6

What's A TOWN Like YOU DOING IN A PlACE Like This

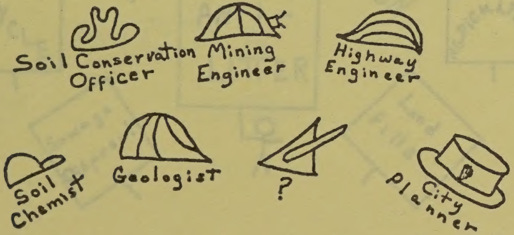
Goal 3

(E)

E A R T H ↓

CAREERS 7

TRY ON A HAT!

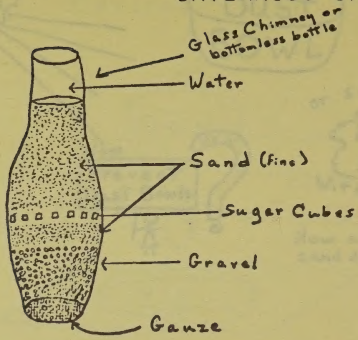

Soil Conservation Officer
Mining Engineer
Highway Engineer
Soil Chemist
Geologist
?
City Planner

Goal 6

(E)

E A R T H ↓

CAVERNOUS CREATION 8


Glass Chimney or bottomless bottle
Water
Sand (fine)
Sugar Cubes
Gravel
Gauze

Goal 4

(E)

E A R T H ↓

UP AND DOWN 9

Find evidence of rock bending in your area.

Goal 4

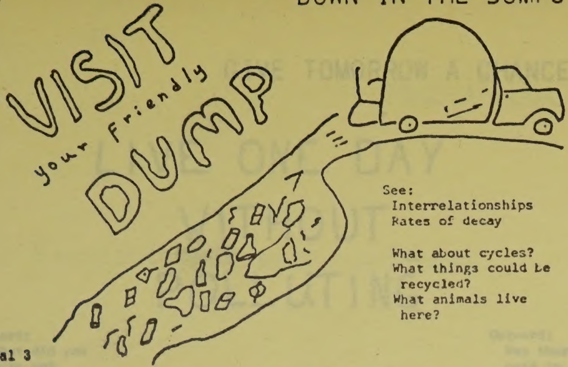
Hmmmmmm:
Map oil well locations

10-5

(E)

E
A
R
T
H
↓

DOWN IN THE DUMPS 10


VISIT
your friendly
DUMP

See:
Interrelationships
Rates of decay

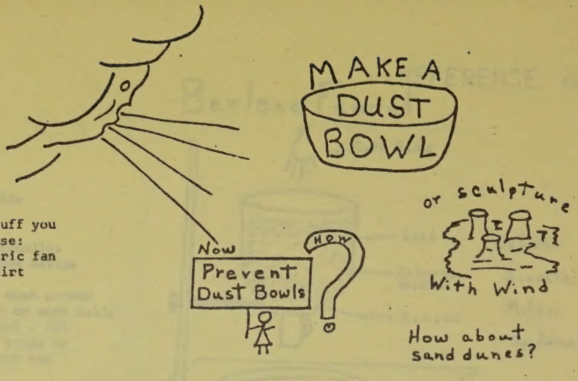
What about cycles?
What things could be recycled?
What animals live here?

Goal 3

(E)

E
A
R
T
H
↓

BLOW HARD 12


MAKE A
DUST
BOWL
or sculpture
With Wind
Now
Prevent
Dust Bowls
HOW
How about
sand dunes?

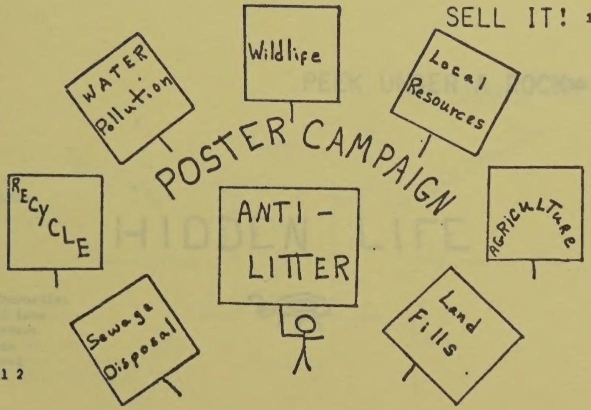
Some stuff you could use:
Electric fan
Dry dirt
Sand

Goal 5

(E)

E
A
R
T
H
↓

SELL IT! 11

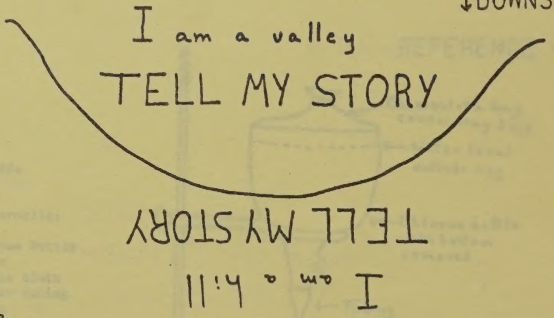

WATER Pollution
Wildlife
Local Resources
POSTER CAMPAIGN
RECYCLE
ANTI-LITTER
AGRICULTURE
Sewage Disposal
Land Fills

Goal 2

(E)

E
A
R
T
H
↓

UPS↑ AND ↓DOWNS 13


I am a valley
TELL MY STORY
TELL MY STORY
I am a hill

Goal 3

(E)

EARTH

GIVE TOMORROW A CHANCE 14

LIVE ONE DAY WITHOUT POLLUTING

Inward:
What did you give up?
How do you feel about it?

Outward:
Was there a need to give it up?

Goal 1

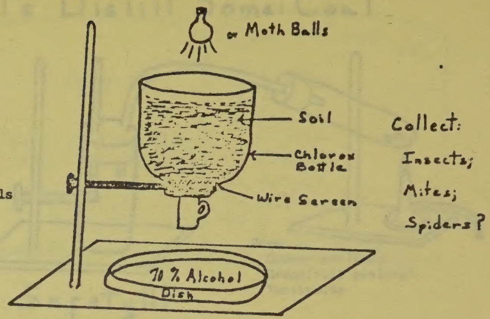
(E)

EARTH

REFERENCE 15a

Soil Life

Paraphernalia:
- Chlorox Bottle
- Dish
- Fine mesh screen
- Light or moth balls
- Alcohol - 70%
- Ring stand or Support box


Berlese Funnel
or Moth Balls
Soil
Chlorox Bottle
Wire Screen
70% Alcohol
Dish
Collect:
Insects;
Mites;
Spiders?

Goal 3

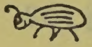
(E)

EARTH

PEEK UNDER A ROCK 15

Soil Life

HIDDEN LIFE



Paraphernalia:
- hand lens
- Tweezers
- Vials
- Shovel

Goal 3

(See reference cards 15a & 15b)

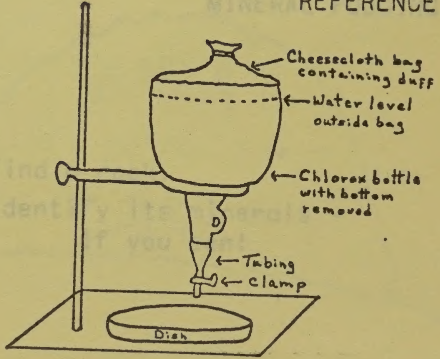
(E)

EARTH

REFERENCE 15b

Soil Life

Paraphernalia:
- Dish
- Chlorox Bottle
- Water
- Cheese cloth
- Rubber tubing
- Clamp
- Ring stand or Support Box


Cheesecloth bag containing duff
Water level outside bag
Chlorox bottle with bottom removed
Tubing
Clamp
Dish

Goal 3

(E)

E
A
R
T
H
↓

TAKE A LOOK 16

Find out what soil contains.

Goal 4

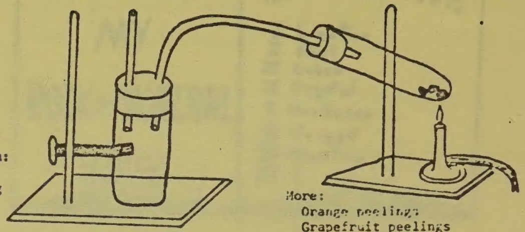
(See reference card 16a)

(E)

E
A
R
T
H
↓

STILL 17

Let's Distill Some: Coal



Paraphernalia:
- Test Tubes
- Glass tubing
- Corks
- Fire
- Ring stands

More:
- Orange peelings
- Grapefruit peelings
- Toothpaste

Safety!!!

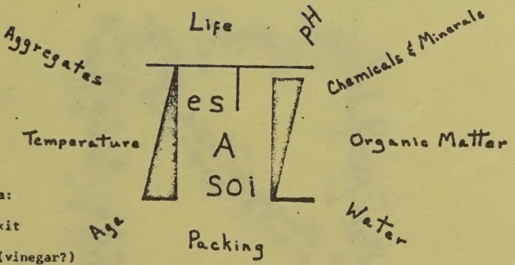
Goal 6

(E)

E
A
R
T
H
↓

REFERENCE 16a

Soil Testing


Aggregates
Life
pH
Chemicals & Minerals
Test A Soil
Temperature
Organic Matter
Age
Packing
Water

Paraphernalia:
- Shovel
- Soil test kit
- Hand lens
- Weak acid (vinegar?)

Goal 3

(E)

E
A
R
T
H
↓

MINERAL PUDDING 18

Physical Properties

Find a rock.

Identify its minerals -
If you can!

Paraphernalia:
- Microscope
- Hand lens

Goal 3

(E)

E
A
R
T
H

BUILDING BLOCKS 19

Design a building.

What materials did you use?

Where did the materials come from?

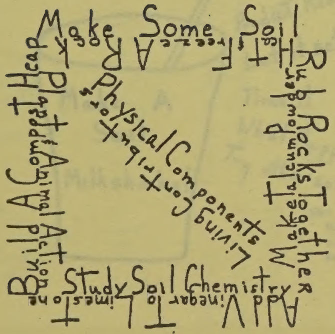
Goal 6

(E)

E
A
R
T
H

Soil Formation

IN THE BEGINNING 20


Make Some Soil
Heat + Freeze A Rock
Rub Rocks Together
Make Talcum Powder
Build A Compost Heap
Plant + Animal Action
Physical Components
Living Contributors
Study Soil Chemistry
Add Vinegar To Limestone

Goal 5

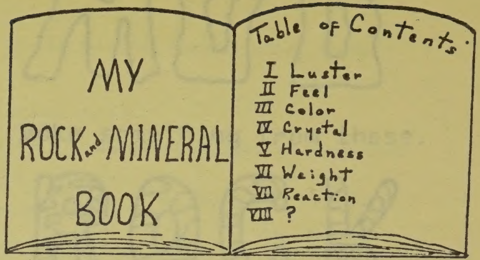
(E)

E
A
R
T
H

Geology

HARD ROCK 21

MAKE ONE-


MY
ROCK and MINERAL
BOOK
Table of Contents:
I Luster
II Feel
III Color
IV Crystal
V Hardness
VI Weight
VII Reaction
VIII ?

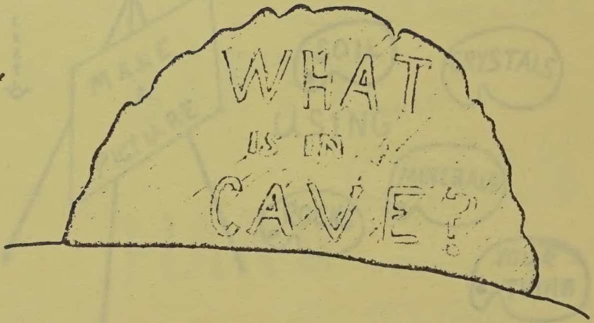
Paraphernalia:
- Knife
- Glass
- Hand Lens
- Microscope
- Hammer
- Scale
- Vinegar

Goal 4

(E)

E
A
R
T
H

CAVE-IN 22


WHAT
IS IN A
CAVE?

Goal 4

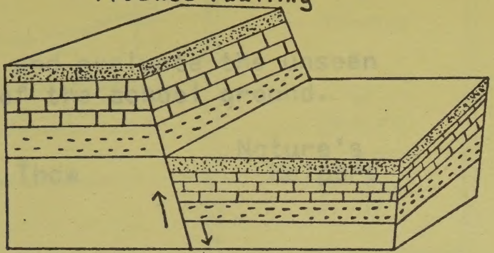
(E)

EARTH

WHOSE FAULT

23

Investigate Causes of Pressure That Produce Faulting



Goal 4

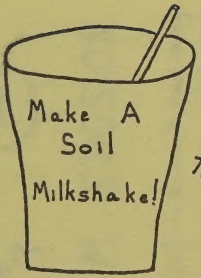
(E)

EARTH

FOUNTAIN SERVICE

24

Physical Properties


Make A Soil Milkshake!

Predict Results
Let it set
Time it
What Happened?
Try other soil

Paraphernalia:
Spoon
Shovel
Glass container

Or:
Make a soil layer cake with sieves or screen

Goal 4

(E)

EARTH

RARE EARTH

25

MUD

Make something from these.

ROCK

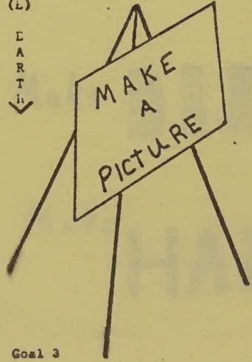
Goal 6

(E)

EARTH

COLOR ME DIRTY

26



USING

SOIL

CRYSTALS

MINERALS

ROCKS

YOUR THING

Goal 3

(E)
EARTH

LOOK AROUND YOUR GROUND 27

Survey and evaluate the unseen world of the school ground.

Erosion
Spring Thaw

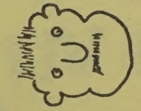
Nature's
Helpers

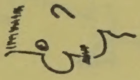
Goal 3

(E)
EARTH

WANTED 28

WANTED





I.M. EROSION

This culprit is known to have many aliases and use several disguises. In order to collect the reward, proof of arrest is required.

REWARD: LIFE

Goal 5

(E)
EARTH

SEARCH OUT 29

INVESTIGATE

The work of the Civilian Conservation Corps

- in your area
- relate its worth to its goals or purposes
- find examples
- values today
- more and more

How about:

SCS
BLM
USFS
USDA
USDI

Wyo. Game & Fish
State Forester
Wyo. Dept. of Agr.
Wyo. Natural Resources

Goal 3

(E)
EARTH

CLEAN-UP CAMPAIGN 30

Make DIRTY water CLEAN

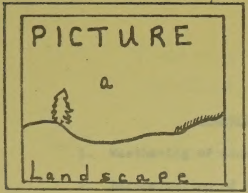
Make HARD water SOFT

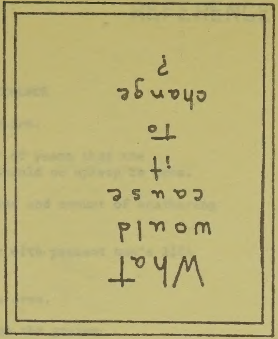
Goal 5

(E)

EARTH

PICTURE ME 31


PICTURE
a
Landscape


What would cause it to change?

Paraphernalia:
- Camera
- Paint (water color or acrylic)
- Pencil
- Etc.

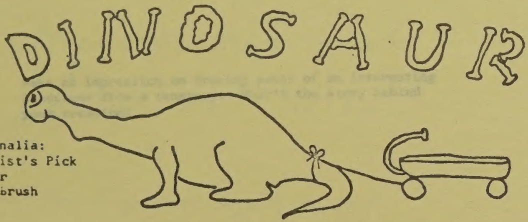
Goal 6

(E)

EARTH

A DINOSAUR CHORE 32

HITCH YOUR WAGON TO A



Paraphernalia:
- Geologist's Pick
- Vinegar
- Small brush
- Knife

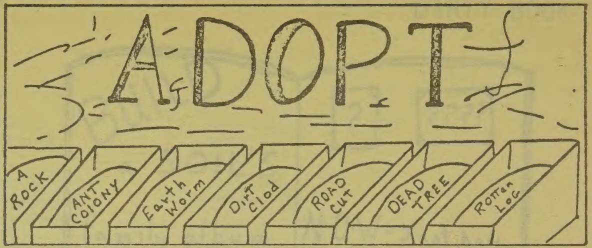
Goal 3

Refer to Fossils of Wyoming

(E)

EARTH

ADOPTION 33


ADOPT
A Rock
Ant Colony
Earth Worm
Dirt Clod
Road Cut
Dead Tree
Rotten Log

REALLY GET TO KNOW IT

What does it effect!

What effects it?

Record changes.

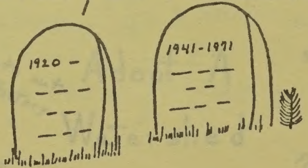
Goal 6

(E)

EARTH

ROCK OF AGES 34

Study In A Cemetery


1920 -
1941-1971

Some have liked:
LIFE Card # 39

SOURCE:
Department of Outdoor Education
University of Northern Illinois

Goal 3

(See reference card 34a and 34b)

10-11

10-12

REFERENCE

CEMETERY REFERENCE

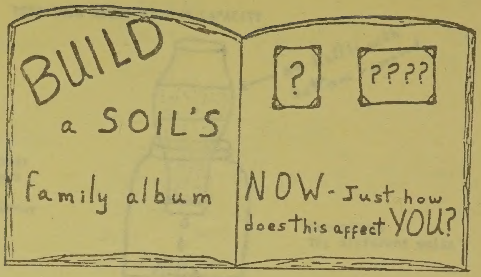
1. Weathering of stone markers.
2. Determination of number of years that the cemetery would endure should no upkeep be done.
3. Relationship between time and amount of weathering of stones.
4. Average life expectancy with present man's life span.
5. Trees and plants of the area.
6. Condition of the soil on the graves.

REFERENCE

Make an impression on drawing paper of an interesting headstone from a cemetery. What's the story behind your creation?

Stuff:
Drawing paper
Charcoal pencil or crayon

DIRTY BOOK



Goal 4

Some have Liked:
Try this with a rock
or geologic formation.

WATERHOLE # 1

Map It

Sleuth out the History

Adopt A Watershed

study the geology

Predict the Future

(Abiotic Factors)

Find & Cure Erosion

Test the Soil

Goal 6

(E)

E
A
R
T
H
↓

WATERHOLE # 2

Cause-effect Relationships

Energy Flow

Similarities

Adopt A Watershed (Biotic Factors)

Water Relationships

Relationships to Man

Patterns

Natural Cycles

Goal 5

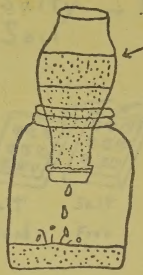
(E)

E
A
R
T
H
↓

Physical Properties

REFERENCE

TEST SOIL WATER-HOLDING CAPACITY



or bottle with bottom removed

Paraphernalia:
- Cheesecloth
- Jar
- Glass chimney
- Water
- Beaker
- String

Quantitate
Try different soils

(E)

E
A
R
T
H
↓

WATER HOLD

Measure how much water, soil holds.

Try different types of soil.

Goal 4

(See card # 38a)

(E)

E
A
R
T
H
↓

HYDROPONICS

OLD MACDONALD HAD A HYDROPONICS FARM
E----- I----- E---- I--- Oooo
AND ON THIS FARM HE HAD A----
?

Paraphernalia:
- Commercial plant food
- Vermiculite

Then he tried
an organic garden.

Goal 5

(See reference card # 39a)

10-14

(E)

EARTH

REFERENCE 39a

Hydroponics Solutions

Calcium Nitrate	10ml
Potassium Nitrate	10ml
Magnesium Sulfate	4ml
Potassium Phosphate	2ml
Iron Chelate	2ml
Trace Elements	2ml

The above stock solutions, except iron chelate and the trace element mixture, are 0.5 Molar. The iron chelate solution is 0.5% in strength; the trace solution contains (per liter) 1,864 mg KCl; 773 mg H_3BO_3; 423 mg $MnSO_4$-H_2O; 288 mg $ZnSO_4$-$7H_2O$; 63 mg $CuSO_4$-$5H_2O$ and 9.2 mg $(NH_4)_6\ MO_7O_{24}$-$4H_2O$

(E)

EARTH

EARTHQUAKE! 40

Build a Seismograph!

Paraphernalia:
- A brick
- Sticks and boards
- Nails and hammer
- Pencil and tape
- String and paper

How can you use a Seismograph?
What's the Richter Scale?

Goal 4

(E)

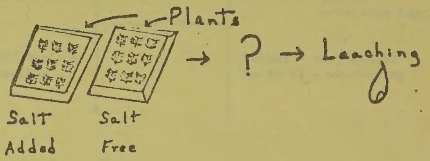
EARTH

Soil Chemistry

HOW SALTY I AM 41

Create "Salty" Soil → Effects? → Cure "Salty" Soil

Paraphernalia:
- Boxes
- Plants
- Soil
- Water
- Salt?



Goal 3

(E)

EARTH

WASH OUT 42

Show erosion - water style.

Paraphernalia:
- Pan
- Soil
- Splash board
- Grass
- Camera
- Etc.

Goal 5

(E)

E
A
R
T
H

TRACER 43

CHOOSE SOMETHING

Trace its origin in the soil.

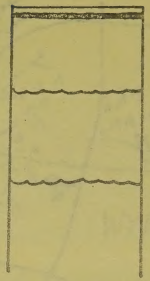
Goal 4

(E)

E
A
R
T
H

REFERENCE 44a

Soil Profile


"A" Horizon
Zone of Maximum leaching
Duff - dead material
Surface - alive!
Subsurface - Roots; dark brown color
"B" Horizon
Zone of Maximum Accumulation
Subsoil - Brown to red or yellow - sometimes hardpan
"C" Horizon
Unconsolidated
Parent - very slight
Material - weathering

10-15

(E)

E
A
R
T
H

FOOD FOR THOUGHT 44

Physical Characteristics

Try Several Locations

A rock Sandwich!

Find a Soil Sandwich

Make one!

Maybe its a Dagwood!

Save a Sample.

Guess its age.

Paraphernalia:
- Shovel
- Geologist's pick
- Camera
- Hand lens

Goal 4

(See reference card # 44a)

(E)

E
A
R
T
H

ROCK TALK 45

Rocks and Minerals

Gather Some Rocks

Group

Identify

Classify

Uses

Origin

Paraphernalia:
- Geologist's pick
- Hand lens
- Microscope
- Acid or vinegar
- Labels
- Scales
- Knife

Goal 4

(See reference card # 45a)

(E)

EARTH ↓

REFERENCE 45a

HARDNESS CHART

Very hard	scratches glass
Hard	knife scratches rock rock does not scratch glass
Medium	penny scratches rock fingernail does not scratch rock
Soft	fingernail scratches rock

(E)

EARTH ↓

THE ASSOCIATION 46

Do géological-botanical correlations in your area.

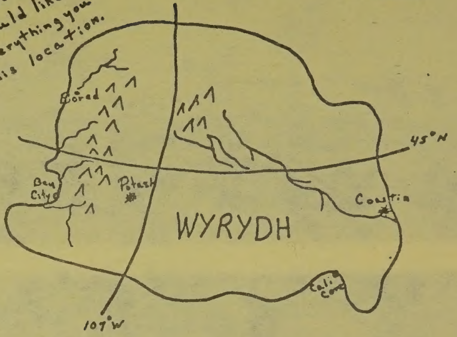
Goal 4

(E)

EARTH ↓

LATITUDE ATTITUDE 47

Choose a place on this continent where you would like to live. Tell everything you can about this location.


Bored
Bay City
Potash
WYRYDH
Cowtin
Cali Cove
45°N
107°W

Goal 3

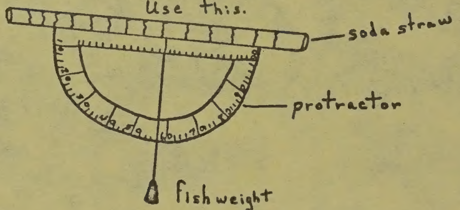
(E)

EARTH ↓

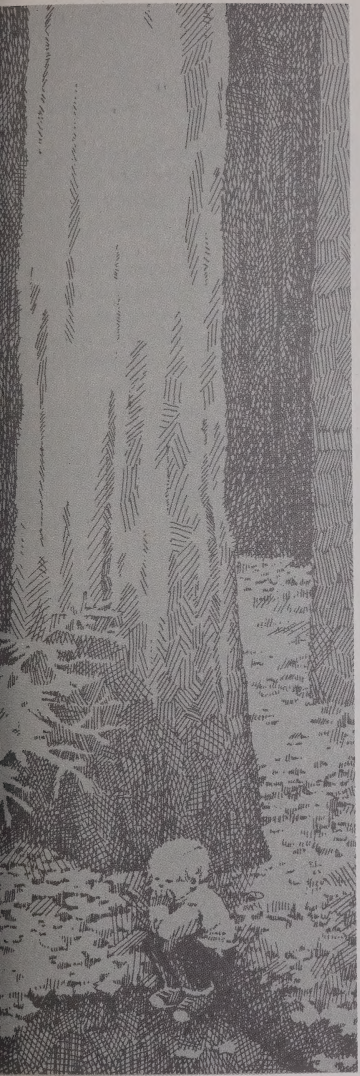
ANGLING 48

Measure the angle of a slope.

Use this.


soda straw
protractor
fish weight

Goal 3



all around you

AN ENVIRONMENTAL STUDY GUIDE

United States Department of the Interior
Bureau of Land Management

March 3, 1849

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
WASHINGTON, D.C. 20240

IN REPLY

TO TEACHERS AND STUDENTS:

We in the Bureau of Land Management are heartened by the mounting concern and leadership which both students and their teachers have been demonstrating with regard to the protection and thoughtful development of our nation's lands and resources. All educational institutions can perform a valuable service by imparting, both to young people and to adults, knowledge and attitudes which will enable all of us to work together to improve the quality of life in this country.

The environmental education materials in this booklet were developed for BLM during Summer 1970 by six young people, schooled in physical sciences, social sciences, and education—and concerned about the future of our environment. The materials were prepared with students at the late elementary and junior high school grade levels in mind, but you will probably find many of the lesson suggestions appropriate for use or adaptation at all grade levels. We hope these ideas will help you develop an awareness—an understanding—for your own surroundings. Given the tools for discovery, we believe students can learn more about, and develop greater responsibility toward, the world about them.

All BLM lands can be used as a living laboratory for the study of land and resource management and protection. We urge students and teachers to use the public lands as outdoor classrooms. We hope you will call on our State and District Office staffs for assistance with your environmental education activities.

Sincerely yours,

Director

BLM Library
Denver Federal Center
Bldg. 85, OC-521
P.O. Box 25047
Denver, CO 80225

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
25TH ANNIVERSARY 1971

FOREWORD

To The Teacher:

People everywhere are becoming concerned about the solution of environmental problems, and about the protection and wise use of our natural resources. We all want to understand more about environmental factors and inter-relationships, and we would like our young people to learn more and to become concerned about our environment so that they can appreciate and use it with greater care in the future.

Although environmental education is based upon ecology—the science of the inter-relatedness of all living organisms in their environment—environmental education also encompasses ideas from all the traditional school subjects. The objective of environmental education is not the mastery of isolated facts and routine skills. Rather the objectives are an understanding of basic environmental inter-relationships and problems, the development of investigative and problem-solving skills, and individual motivation to help solve environmental problems.

Since the objectives of environmental education are so relevant to our personal interaction with our environment every day, we hope that ideas from environmental education can be woven into the daily classroom schedule so that they can somehow tie our classroom experiences more closely to our own lives. The student will understand best those things and inter-relationships around him that he explores and discovers for himself; he may see how each thing relates in some way to his life. You can offer every student the opportunity to use his natural learning ability, at his own speed, to investigate inter-relationships and ideas that interest him and are important at the same time. Positive motivation and feelings of self-accomplishment should result.

There is no need to use the sections and questions in this book in the order that they appear. Throughout the year you will probably want to use the separate pages freely, in accordance with your students' interests, their learning levels, and the regular school subjects you want to teach. We believe the questions and ideas in this book will stimulate each student to pursue interests and new ideas on his own. As you see these interests growing, you can share his enthusiasm and guide his learning at appropriate moments.

You may ask: "How can I answer my students' questions?" No one can learn everything about Nature and ecological relationships overnight. The Teacher's Pages will introduce you to the world of ecology and set you to exploring right along with your students. We hope the perspectives provided by the Teacher's Pages will enable you to help your students find some answers to their questions—through practical investigation, through aboratory and library research, and through talking with knowledgeable people. The Teacher's Pages will follow an alphabetical letter sequence so that you can remove them from this book without disturbing the Arabic numeral sequences of the pages designed for the students.

The activities in "All Around You" begin in the classroom and move outside to the schoolyard, the town, and natural or rural areas. All of these places offer good opportunities for environmental study. You and your class may wish to visit the public lands, where a variety of resource utilization and conservation programs are underway. If you are interested, the personnel at your nearest BLM office, or at other resource management agencies, can help you determine what areas are available and most suitable for your purpose, and suggest some of the learning opportunities these areas present. If you visit the area and become familiar with its history, its physical features, its usage, and unique environmental relationships or problems before you take your class, the uccess and enjoyment all of you derive from your outdoor experience will measurably increase.

If you already have a favorite place or area you are familiar with which you think will help your students better understand environmental relationships, by all means use it. We hope you will enjoy getting to know your nvironment better!

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
Price: $2.35, domestic postpaid; $2.00, GPO Bookstore Stock Number 2411-00043

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Teacher's Page

No matter where we come from, each of us carries at least a few vivid impressions from our childhood and youth. Many of these memories involve our relations with family and friends. We can also recall some very pleasant and meaningful experiences which acquainted us better with the world around us. One of us remembers the quiet, dewy mornings, the birds chirping as the sun streamed in the bedroom window; another remembers that first real adventure in the forest, a mixture of freedom, fear, and awesome wonder; a third recalls the friendly human interchange, the bustle and confusion, the slender shafts of sunlight in the morning on a skyscraper-lined city street.

What do you like to remember most? And now, what experiences does your environment offer which bring stimulation or a feeling of contentment? A soothing, rippling woodland brook? The fresh breeze in the open country? The laughter and chatter of happy people in a cool green city park? The warmth and cheeriness of your neighborhood, or another neighborhood in town? What parts of your environment make you feel the happiest?

In every part of the country, the pace of our lives is increasing. We need to stand still for a moment and enjoy these experiences which enrich our lives. Today, as people realize how important their environment is to them, they are becoming more concerned to protect the quality of the environment and improve it. This requires more than an appreciation of one's surroundings; it requires some understanding of the inter-relationships among all parts of the biological community, including Man. Scientific experts are at work on many of our environmental problems, but we can't begin to solve these problems unless every individual places value on a healthy environment and is motivated to help as much as he can. If you are concerned, encourage others to become more sensitive to their environment, and to learn more about preserving and creating healthful environments to live in.

SECTION I

Awareness:

Your Environment Is All Around You

HAVE YOU THANKED A GREEN PLANT TODAY?

Did you see a green plant?

Did you see the grass growing in the sidewalk cracks?

Did you see the dandelion growing in the street next to the curb?

What things have you seen today? Do you remember anything about them? What were their colors? Did they make any noise? How did they smell, and taste?

Let's explore!

YOUR ENVIRONMENT IS ALL AROUND YOU!

The exploration of your environment will begin here, wherever you are right now, which is probably in the classroom. To explore, use your senses!

SEEING
FEELING
SMELLING
HEARING
TASTING

These are the tools you will use; they are all you need.

If you are like most people, your senses may need a little tuning up. Today in our machine-age cities, people rely less and less on their senses and more and more on machines for information about the world around them. They can go through life looking without ever seeing, touching without ever feeling, and listening without ever hearing. It is an easy, but dull existence.

Developing greater sensitivity can be fun. By using your senses to their fullest, you will become more aware of both yourself and your surroundings -- in other words, of your environment.

Start with the big blob of things you can see out the classroom window. Everything in the world is different and everything means something different to every person. Differences can be in color, texture, shape, smell or any other quality. Even though things are different there still are many ways in which they are alike.

What sort of things do you see out the window? Take some time and don't just look; try to really SEE!

Things I see:

You have used your eyes to notice some things outside the window. This is only a beginning. Your eyes can tell you more than just what objects are present. They can show you how things are alike, different, and how they are related. Let's investigate some of these relationships.

Are some of these things alike in some way? How are they alike? For example, are they the same color? size? texture?

Our environment is a constantly changing dynamic system. Like the movement of a clock's hour hand, change may be imperceptible, but it is constantly occurring. Buildings are crumbling, mountains are being born, and people are growing older. Any interaction between two members or factors in the environment produces a change—even if you and I are not here long enough to see it happen.

If you take a leisurely walk in your neighborhood or another neighborhood in town, you will see many changes taking place. Some are for the better; they improve people's lives. Other changes are the result of man's neglect or misuse of resources. To accomplish change, people must pool their efforts and, in some cases, their funds.

In a world that is changing so rapidly, we need a better understanding of the kinds of change that will benefit man. Because the needs and interests of individuals vary, they will not always agree that specific changes should be made. But if the conditions and changes which make for a healthy, balanced environment can be identified, these should become our common goal. Scientists must investigate some of these changes. However, we can use our own common sense to recognize basic changes needed, such as cleaner water. We can express our personal preferences concerning the kind of community that we think would be healthy and pleasant to live in. Working together, we can bring about many important changes ourselves.

In what other ways might these things be alike? Think about what they do in your environment. What is heir function?

In what ways are the things you have listed different?

Are any of these things changing in any way? If they are, how? What is causing these changes?

What is changing?	How is it changing?	Cause of change?

Are there any objects on your list that look as though they aren't changing? If there are, how do you think they will look in 10 years? 100 years? 1,000 years?

Objects	10 years	100 years	1,000 years

From your list pick out your favorite thing . . .
Use one word to name what it is.
Can you use two words to describe it?
Three words about what it is doing?
Four words to describe how you feel about it?
One word which, to you, means the same as the first word?

For Example:

walls
big small
fences stop dividers
keeps one from another
tall*

Your Favorite Thing:

____
____________ ____________
____________ ____________ ____________
____________ ____________ ____________ ____________
____

You just wrote a poem called cinquain (sin-kane) about your favorite thing which you saw from the window.

Is there anything you saw from the window which you didn't like? What are some of the things you didn't like? Why not?

Write a cinquain about a thing you saw which you did not like. Compare it to the first cinquain you wrote.

____
____________ ____________
____________ ____________ ____________
____________ ____________ ____________ ____________ ____________
____

---

* adapted from a cinquain by Mary: Charline McDonald; "A Place I Like," Washington Education, Washington Education Association, March 1970

If you could change some of the things you saw which you didn't like very well, what would you do to them and how would you go about doing it? Would your changes result in other changes or side effects?

Changes I Would Make	Possible Side Effects

> When we try to pick out anything by itself, we find it hitched to everything else in the universe.
>
> –John Muir

Teacher's Page

COLORS SOUNDS SMELLS

Colors, smells, and sounds are an exciting part of anyone's environment. They add a great deal of enjoyment to our lives if we remember often to notice them. They tell us what season it is, whether other living beings are far away or nearby, and what the condition of our environment is.

Can you imagine a world without colors? Without smells? Without sounds? In that kind of world, the thoughts and ideas you could conceive and express would be severely limited. Our ways of communicating with other people would be markedly reduced.

Colors, sounds, and smells seem to have very definite effects on the way we feel, and even on the way we act. Each individual uses colors, odors, and sounds to identify other people and to develop his own self-image.

Colors, smells, and sounds in Nature offer great diversity and beauty in what might otherwise be a very dull scene, and many of them can not be reproduced by Man. On the other hand, think of the unique colors and sounds man has produced through technology, and especially through music, the visual arts, and literature. There are even some man-made odors we really like, such as fresh-perked coffee, or home-baked bread!

Colors

Like acrobats on a high trapeze
The Colors pose and bend their knees,
Twist and turn and leap and blend
Into shapes and feelings without end.*

Notice the colors of the things on your list which you didn't like very well. Compare these to the colors of the things you did like. Is there any difference? If so, what is the difference?

What is your favorite color? _______________ . How does that color feel? How does it taste? How does it smell? How does it sound?

feel ____________________________
taste ___________________________
smell ____________________________
sound ___________________________

List the things you observed from the window which are your favorite color.

Things My Favorite Color:

1.
2.
3.
4.
5.

Let's go outside and take a closer look at what you have been observing and thinking about!

Take a good look at the natural objects around you. What colors are present in the natural objects you can see?

Natural Objects	Colors Present
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.

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Compare these colors to the colors of the man-made objects, including clothing, you see. Where is the greatest variety found, in Man or Nature?

Where is your favorite color found most often, in man-made objects or in natural objects?____________________ . What purpose does the color serve in these objects?

What colors are the animals and birds that you see or have seen? What do these colors do for the animal or birds? Can you think of how colors help animals or birds survive?

Animals/Birds	Color	What the color does

Notice the advertising around you. What colors are present?

What role do colors play in advertising? For example, is a colored sign more interesting than one which is black and white?

Do colors affect and change you and your behavior? How? For example, think about how you would feel in an all-black room. What do colors have to do with your choice of clothing?

The Colors live
Between black and white
In a land that we
Know best by sight.

But knowing best
Isn't everything,
For colors dance
And colors sing,
And colors laugh
And colors cry –
Turn off the light
And colors die,

And they make you feel
Every feeling there is
From the grumpiest grump
To the fizziest fizz.

And you and you and I
Know well
Each has a taste
And each has a smell
And each has a wonderful
Story to tell. *

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Smells

We have a habit of not using our senses to their capacity. The sense of smell is one we probably ignore the most. This is unfortunate since smells can tell you a lot about your surroundings.

Stop for a minute and use only your nose. Breathe deeply and take notice of everything your nose senses. List the different smells you can pick out. Where do they come from?

Smells	Where they come from

Are some smells more pleasant than others? ________________. Which ones are they? Why do you like them better?

How often do you rely on your sense of smell? Think about what your sense of smell does for you in your everyday life. Give some examples of how you use your sense of smell.

Examples:

Would it be possible to develop your sense of smell so that it could do more for you? If you think it would be, how would you do it?

Imagine that you are living in a forested area in North America about 400 years ago and that for your survival you depend on deer hunting. How important a role would your sense of smell play in your survival? Why?

Does this tell you anything about why your sense of smell isn't very acute? What?

Describe how it smells outside when the first rain is just beginning to fall after a dry period. Use a cinquain, sketch, story or anything else to make this description.

Sounds

The sound of black is
"Boom! Boom! Boom!"
Echoing in
An empty room. *

Sounds are an exciting way to learn more about your surroundings. They can tell us a lot when we are aware of them, of where they come from, and of what they mean.

Listen for a moment . . . what sounds do you hear? What is the source of each sound?

Sound	Source

How are these sounds similar? How are they different?

For example:

some are soft, some are loud

Are some sounds more pleasant than others? Which ones are they and why do you like them better?

---

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Stop and listen at different times during the day. Do you hear different sounds at certain times in the day? Where are they coming from? Why do you hear some sounds at one time during the day and not at another?

Are there any sounds that never stop? What are they? If they never stop, why don't you hear them all the time?

Listen again. What is the smallest sound you hear? Try describing this sound with a cinquain as you did earlier with your favorite thing.

____

____________________ ____________________

____________________ ____________________ ____________________

____________________ ____________________ ____________________ ____________________

____

The tiniest sound in the world
is a snowflake
as it
falls
from
the
sky
and
gently
turns
into
a
tear.

Can you imagine what the tiniest sounds in the world are? Describe what you think the tiniest sound is, using a sketch, a poem, or anything else you wish.

YOUR SENSES: USING THEM ALL AT ONCE

What is your very favorite place in the world? ______________ . Describe it using all of your senses, trying this method for a start:

Use one word for color ______________
Use two words for how the place feels ______________
Use three words for how it sounds ______________
Use two words for how it smells ______________
Use one word for how it tastes ______________

Make up your own ways of describing your favorite place. Use words, sketches, anything you wish. See if some of your classmates can figure out what your favorite place is just by looking at your description of it.

I like this place because it is up high and it is comfortable. Across the street there is a big pipe. It makes a noise that sounds like music.*

*from: Charline McDonald "A Place I Like," Washington Education, Washington Education Association, March 1970.

COMPARING

You have done some work both inside and outside.

Did the things you observed from inside the classroom seem different when you looked at them outside? How were they different and why?

Are things more interesting to you when you can use more of your senses to find out about them? Why?

> "I discovered the secret of
> the sea in meditation upon a
> dewdrop."
>
> —Kahlil Gibran

You have completed some activities designed to help you see and understand the world around you. This is only a start; there is much more you can do on your own. Developing your senses takes time and some work, but it is worth it! What you will do on your own is even more important to you than what you have already done. As you continue with this guide, use your imagination and most of all your senses.

SECTION II

The Urban Ecosystem

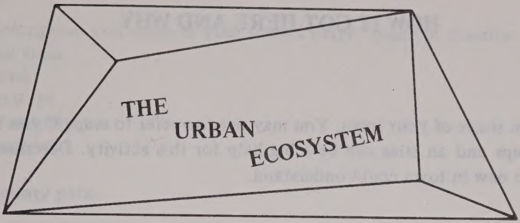
Teacher's Page

Long before man arrived, natural ecosystems existed on earth. The inter-relationships of organisms in hese ecosystems were very complex, but in the long run they were naturally regulated and balanced. Man ntroduced the urban settlement and gradually developed ways to deliver essential commodities from the natural nvironment to urbanized man.

Man's urban settlements have grown and urban inter-relationships, or urban ecosystems, have become ncreasingly complex. But no matter how urbanized a man's way of life becomes, he and his neighbors are still art of the intricate natural ecosystem, too. Man depends upon plants and animals, sunshine, water, air, and soil or his life and good health.

Every town has a history of settlement or urbanization. Some towns were founded with a large population mind; some were not. Similarly, some towns expanded in a rational manner, while others mushroomed overight. If you are trying to imagine what caused people to "urbanize" or move to your own town, think about ome familiar urban settlements in history, such as ancient Greece or Rome. What reasons did these people have or joining together in an urban community? Are some of these reasons still operative today? What problems do ou think these ancient communities had in relating to their natural surroundings, and how did they attempt to olve these problems? The urban ecosystem today may be more complex, but it still relates directly to the atural ecosystem surrounding it.

Your path from the urban ecosystem to the natural ecosystem is more direct in some towns than in thers. Each urban ecosystem promotes a certain style of life which depends on the town's size, its design, its unction(s), its location, and many other factors. How does your town influence your life? You are closely elated with many elements in your urban ecosystem. You can influence some of these environmental factors, ust as they influence you.



THE URBAN ECOSYSTEM

Most of us live in a town. Some towns are small; others are very large. Each town has reasons for being what it is. Some were started because of ranching, others because of logging, others because of transportation. For some reason people came to live in a town. People of all types. People with different backgrounds. People with different goals. People living their lives in different ways.

How do you fit into your town?

How does your town affect your life and the lives of other people in it and around it?

HOW IT GOT HERE AND WHY

Describe or sketch the shape of your town. You may need to refer to maps if you live in a large town or if you haven't seen it all. Maps and an atlas can be a big help for this activity. Describe or sketch your town's shape in a way that a person new in town could understand.

In the sketch or description you made of your town's shape, locate or describe:

1. residential areas
2. major stores
3. main highways
4. railroads and airports
5. large industries
6. schools
7. city or county parks

Why is your town shaped the way it is? As you investigate this question, record the natural and man-made features which cause this shape. Also, look into the history of your town area. What role did people play in influencing the shape of the town?

Man-made features	Natural features

Has your town always been this shape? ____________________

Make a simple sketch of how you think it looked:

25 years ago:

50 years ago:

100 years ago:

Why do you think this town was started here?

Finding out if you are correct can be fun. Dig into the history books and talk to some of the old-timers in town who probably have some interesting stories to tell about your town's beginning.

Is this the same reason your town exists now? ________________
If not, what is the new reason for its existence?

What are some of the advantages and disadvantages to the town's location in relation to its growth? Think bout how the town's location would affect it if the population were rapidly increasing, or if the town wanted make improvements in its facilities and buildings.

Advantages	Disadvantages

What is the average winter temperature for your town or the closest town to you?

What is the average summer temperature? When is it the wettest in your town? When is it the driest?

winter ____________ wet ____________
summer ____________ dry ____________

What natural features most affect the climate of your town? Think especially about major land features uch as mountains, lakes, etc.

Do you think the climate is a major reason for your town existing where it is now? Why?

How does the climate of your town affect your life? For example, do you need air conditioning in the summer? Do you need extra heavy clothes in the winter?

The liveability of a town depends to a great extent upon the way its land area is utilized. Land can be used for many purposes, for example: for people (parks, malls, housing developments, scenic easements, open spaces); for institutions (schools, libraries, museums, prisons); for industry; for transportation (parking lots, wider streets, freeways, airports).

With our rapidly growing population, making proper land use decisions has become increasingly important and also difficult. There are many kinds and levels of land use planning done at different governmental levels. At the local level, many jurisdictions are adopting tools for land use control, such as zoning regulations, flood plain zoning, housing codes, construction codes, use permits, sanitation regulations, and pollution standards. You may also be interested in comprehensive land use planning proposed at the state and national levels; in some states, statewide planning, either comprehensive or for specific purposes, is already underway.

Thinking about your town's present land uses, perhaps you will say, "If only we could start over again!" You could list all the needs of your expected population and, through a process of compromising and balancing needs, design the ideal community. At the same time, you would evaluate the natural resources on your town site to determine the kinds of development that would suit each place best, and to identify those natural resources of aesthetic or environmental value which would require protection. You would establish land use and governmental controls to regulate urban growth from the beginning.

The designers of "new towns" in the United States and other countries are lucky because they can start from the beginning in planning a town (although designing a liveable "new town" is challenging, difficult work!). But "new towns" cannot meet all our people's needs. Those of us who live in old towns need effective land use planning and controls even more. Over a period of time, strong enforcement of these controls can help us preserve our cultural heritage while, at the same time, improving our buildings, our streets, and our open spaces to make life healthier and more pleasant for everyone.

Land Use

Land is a basic resource for all living things. How has the land in and around your town (urban and suburban) been used in the past? How is it being used now? How do you think it will be used in the future?

Sequence of land use in your town area

Land user	Use of the land	Type of settlement	Effects on environment	What residents value in the environment
Past				
Present				
Future				

Look closely at the map you made of your town. How much land is devoted to parks, shopping areas, industrial sites, etc.?

Use	How much

How would you like to see the land in your town area used in the future?

What agencies or offices make the land use decisions that affect your town?

Does your town have zoning laws? ________________ If so, what types of zones are there?

List:

Does your town have any serious problems related to land use, such as major erosion, land slides, or floods? Are there provisions in your town's zoning laws to deal with these problems?

Land use problems	Zoning law provisions

Keeping the zoning laws of your town in mind, do you think land uses and the shape of your town might change in time if these laws were modified in some way? Why?

How does your town compare with its nearest neighbor? Think about the land use, climate, natural features, size, etc.

The nearest town is: ____________________________
Comparison:

Without people, a town has no reason to exist. These days we are concerned that every town fulfill its purpose: to meet the needs of the people who live there.

People come to towns for many reasons. Some people bring a skill, seeking employment to earn their living. Some seek protection from the outdoors; they want the comforts of an urban home and life style. Some crave the opportunity to meet and learn from other people with backgrounds different from their own. And others seek the companionship of friends, or of an entire community which shares their customs and values. You can easily add more reasons to this list.

A variety of cultural histories and customs in any town lends richness to its character—to its streets and buildings, its celebrations, its political life, and to the moods of the people you see everyday. If we become interested in the life styles, in the pleasures and problems of people with backgrounds different from our own, we make new friends and at the same time grow to understand and appreciate our own lives more.

But as urban populations grow, governmental and other organizational structures must be developed to assure that people's basic needs are met, and that our resources, both natural and man-made, are being used to provide our people the best life possible. In most towns, the needs of some people are not being met. It is important that we recognize and attempt to correct poor living conditions if they exist in our towns. Towns are for all the people!.

YOUR TOWN AND THE PEOPLE WHO LIVE THERE

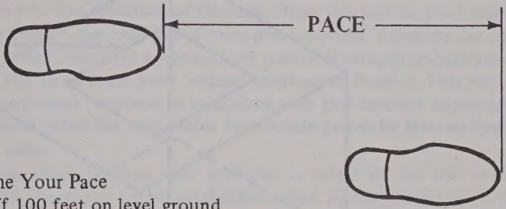
Population is more than just a certain number of residents. It is people, their similarities and their differences, that make population study interesting.

When studying the population and its traits, mapping is a useful tool. Before studying your town's population, spend some time learning how to make maps.

Mapping: A Useful Study Tool

It is important to know where you are! This is one reason people use maps. There are many types of maps for many different purposes. Sometimes it is useful to make your own map for your own purpose.

To make your own map, you must first determine your pace. Your pace is the distance you travel each time you take a step.



How to Determine Your Pace

1. Mark off 100 feet on level ground.
2. Travel the distance marked off in a normal walk. Do this twice, and count your steps each time.
   number of steps taken first time ___________
   number of steps taken second time ________
   Total Steps Taken ________

________ ÷ ________ = ________
total distance walked ÷ total number of steps taken = your pace

Using Your Pace

1. When pacing, be sure to walk in normal easy strides (the same one you just used to determine your pace).
2. Count the number of steps it takes to walk the distance you need to know.
3. Multiply the number of steps taken times your pace.

________ x ________ = ________
number of steps taken x your pace = distance traveled

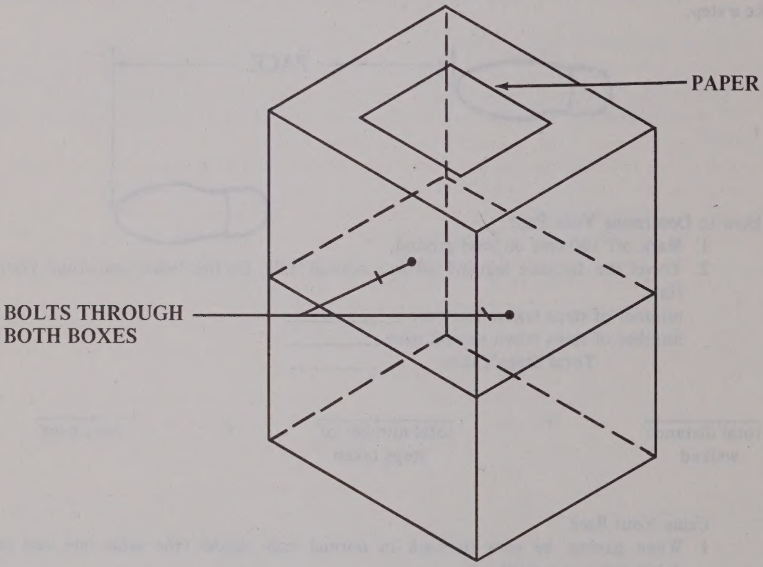
How far is it from:
your classroom to the office and back?________
your classroom to the gym and back?________
your class room to the bus stop and back?________
your classroom to the tallest thing in your schoolyard and back? ________

Directions For Making Your Own Map—Materials Needed:
(Try this on your schoolyard.)

2 cardboard cartons, the ends of each having minimum dimensions of 10" x 14"
2 bolts (¼" x 1") with which to fasten the boxes together (or nails)
1 sheet of unlined paper 8" x 10½" minimum
1 wooden 12" ruler
2 tacks or brads, ½" long
cellophane tape or masking tape
pencil
2 stakes, one blue-flagged and one red-flagged

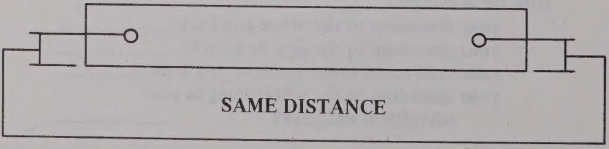
Method of constructing a plane table

1. Place one box on top of the other on their ends or sides depending upon your height.
2. Using the bolts, fasten both boxes together.



3. Fasten the paper to the end of the box, using the cellophane tape or masking tape.
4. Drive the brads or tacks into the ruler; both tacks must be equidistant from each edge.

12" RULER



These will be used as sighting guides during mapping.

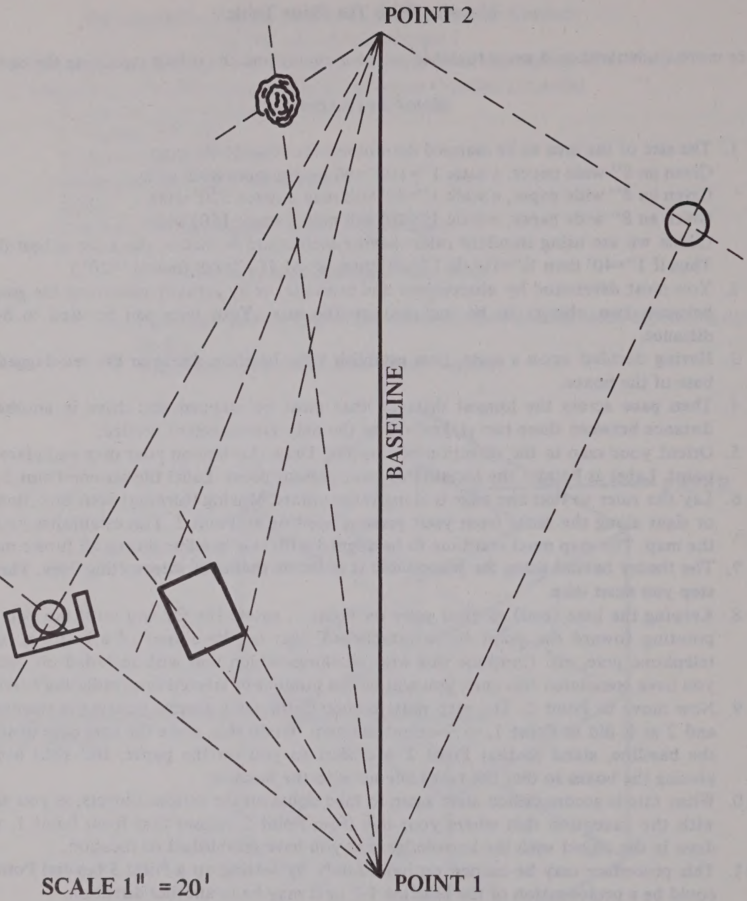
5. The table is now ready.

Mapping With The Plane Table

Two or more students should work together—some mapping and the others steadying the equipment.

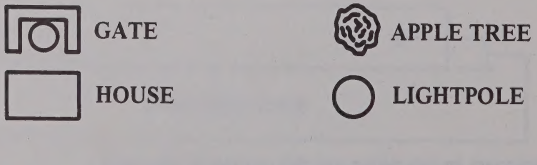
Method of mapping

1. The size of the area to be mapped determines the scale of the map.
   Given an 8" wide paper, a scale 1"=100' will map a space 800' wide.
   Given an 8" wide paper, a scale 1"=40' will map a space 320' wide.
   Given an 8" wide paper, a scale 1"=20' will map a space 160' wide.
   (Since we are using standard rulers having inches and ¼ inches, the scale is best divisible by 4. Thus if 1"=40' then ¼"=10'. If 1"=20' then ¼"-5'. If 1"=80' then ¼"=20'.)
2. You must determine by observation and estimate, or by actually measuring the greatest distance between two objects to be included on the map. Your pace can be used to determine this distance.
3. Having decided upon a scale, now establish your baseline. Drive in the red-flagged stake at the base of the boxes.
4. Then pace across the longest distance that must be mapped and drive in another stake. The distance between these two stakes will be the only measurement needed.
5. Orient your map in the direction of this line. Draw this line on your map and place an X at each point. Label as Point 1 the location of your present point. Label the far one Point 2.
6. Lay the ruler so that one edge is along these points. Moving (turning) your box, line up the tacks or sight along the tacks from your present position to Point 2. This establishes your baseline on the map. The map must continue to be aligned with this baseline during all future mapping.
7. **The theory behind using the plane table is to locate points by intersecting lines. This is the next step you must take.**
8. Keeping the base (end) of your ruler on Point 1, rotate the far end until the two tacks line up pointing toward the point to be established, that is, the corner of a building, a tree, porch, telephone pole, etc. Continue this with all things which you wish included on your map. When you have completed this part, you will have a number of labeled lines radiating from Point 1.
9. Now move to Point 2. The map must remain in the same general position in relation to Points 1 and 2 as it did at Point 1, so re-orient the map. To do this, place the heel edge of the ruler along the baseline, stand so that Point 2 is closest to you on the paper, and sight back at Point 1 placing the boxes so that the tacks line up with the baseline.
10. When this is accomplished start again to take sights on the various objects, as you did at Point 1, with the exception that where your line from Point 2 crosses that from Point 1, you can now draw in the object with the knowledge that you have established its location.
11. This procedure may be carried on indefinitely by setting up a Point 3 beyond Point 2, etc. This could be a prolongation of the baseline 1-2 or it may be in another direction.
12. When you have finished your mapping, set up your scale, a legend, date the map, label the area, and have the crew members sign it.


POINT 2
BASELINE
POINT 1
SCALE 1" = 20'

CREW:	**MJ**	**DATE:**	**JUNE 19, 1970**
	DH	**AREA:**	**RANCH HOUSE LAWN**
	BT		

LEGEND


GATE
HOUSE
APPLE TREE
LIGHTPOLE

People in Your Town

How many people live in your town or city? ______________________

Do a lot of people come into your town during the day for business, shopping, work, etc.? If so, where do they come from?

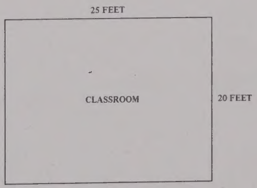
Is most of the population of your town located in the center or is it evenly spread out? ______________________ In order to find the answer to this have someone in your class contact your local tax assessor. When you receive your information, plot the population on a city map in your classroom.

Why do you think people live in cities?

Reasons why:

How large an area does your whole city occupy? ______________________ See if you can determine this by looking at a map.

How large an area does your classroom occupy? Using your pace, determine the length and width of your classroom. Multiply the length times the width. This gives the area of your classroom in square feet.



25	x	20	=	500
length		width		square feet

Your Classroom:

______	x	______	=	______
length		width		square feet

Next divide the number of people in your class by the number of square feet available. This equals the population density of your classroom, or the number of persons in a given area.

________	÷	________	=	________
number of people		number of square feet		population density per square foot

Knowing the number of people in your town and its approximate size, can you determine its population density? You can use square feet or square miles. Which is best?

What areas in your city or town are the most crowded? Locate these areas on the map of your city.

Areas:

If you have a chance, observe some of these most crowded areas. Are they similar in any way? _______________ If so how?

Express how you feel about these areas using a sketch, a poem, a collage, etc.

Why do people live in crowded areas of their city?

Think about and look into the cost of living in crowded and uncrowded areas. Is there a difference? As a class you may want to complete the following chart:

	Crowded Area	Uncrowded Area
Average:		
rent		
food cost (per week per family of 4)		
utility cost (per month)		
electricity		
water		
phone		
transportation to work		

Does crowding in the city have anything to do with other problems such as poor schools, unemployment, or racial discrimination? How?

Do some experiments on crowding with your own class. For example, for one day try doing your regular class activities in half of the space you normally use.

It it pleasant to be in a crowd?________________, How do you get along with other students when you're crowded together like this?

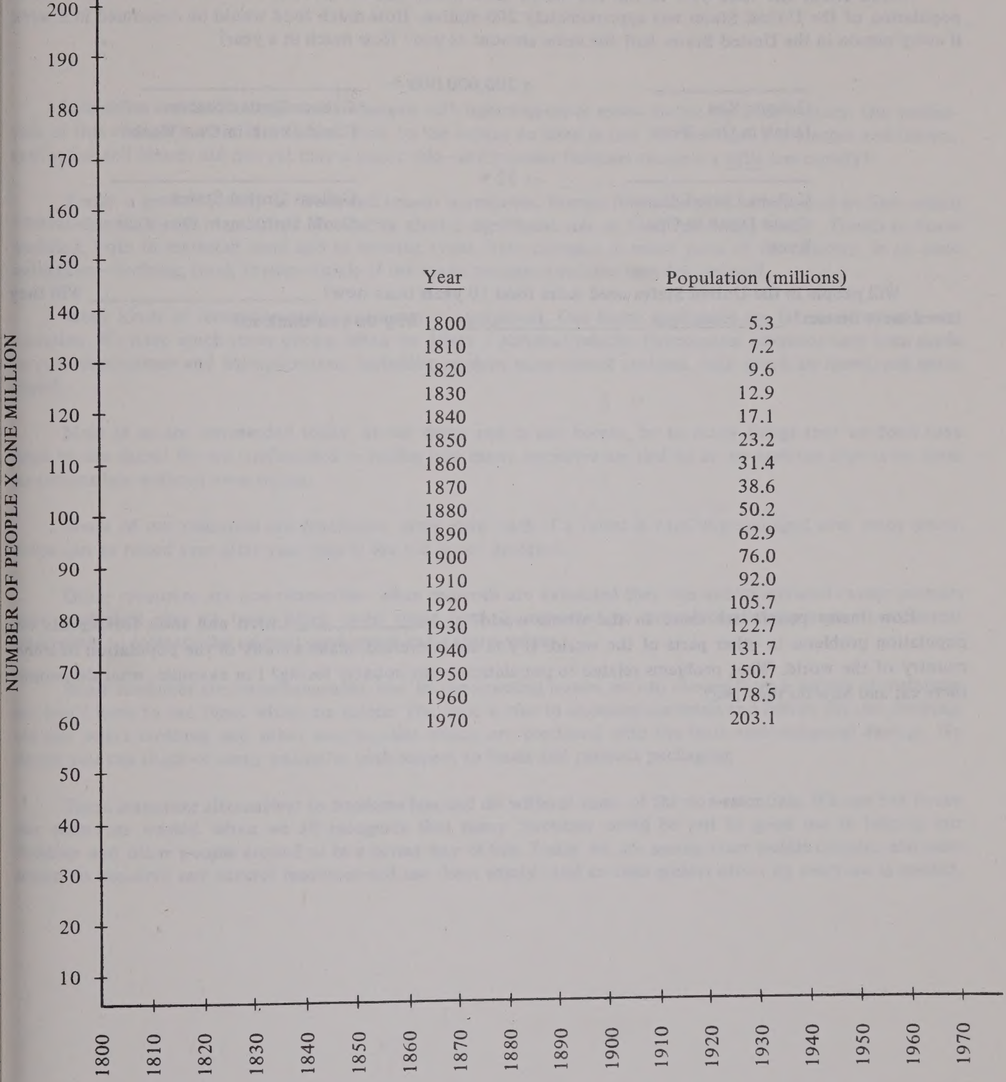
Using a short story, poem, or sketch describe how it feels to work in a crowded area.

In a park area or your city observe the activities of birds and animals such as sparrows and squirrels. Notice their behavior in relation to each other's area or territory. What do birds do when other birds approach an area where they are finding food?

What does man do when someone approaches his "territory"?

Thinking back on your study of population and the effects of crowding, how much space do you think an individual human needs to survive? Square feet ______________________ . Did other students in your class come up with the same figure? ____________________

Draw a graph of man's population in the United States from 1800 to 1970.



Year	Population (millions)
1800	5.3
1810	7.2
1820	9.6
1830	12.9
1840	17.1
1850	23.2
1860	31.4
1870	38.6
1880	50.2
1890	62.9
1900	76.0
1910	92.0
1920	105.7
1930	122.7
1940	131.7
1950	150.7
1960	178.5
1970	203.1

Think about the food you eat in one week. How much milk do you drink in one week? In 1970, the population of the United States was approximately 200 million. How much food would be consumed in a week if every person in the United States had the same amount as you? How much in a year?

________________	x 200,000,000 =	________________
Gallons You Drink in One Week		Gallons United States Could Drink in One Week
________________	x 52 =	________________
Gallons United States Could Drink in One Week		Gallons United States Could Drinking in One Year

Will people in the United States need more food 10 years from now? ________________ Will they need more houses? ________________________ Why do you think so?

How many people are there in the whole world? ____________ Listen and look for reports on population problems in other parts of the world. If you are interested, make a study of the population in some country of the world. What problems related to population is the country facing? For example, what do people there eat and how do they live?

Life styles and technologies have changed with lightning-quick speed during the 20th century. Our realization of this change is vivid if we think back to the homes we lived in just 20 years ago. For clothes and fabrics, synthetics and blends did not yet play a major role—and popular fashions changed a little less rapidly!

Today a greater variety of foods and brands is available. Frozen foods are used widely, and we have added "freeze-dried" to our vocabulary. Packaging plays a significant role in food marketing today. Trends in home building, both in materials used and in housing types, have changed in many parts of the country. In all these categories—clothing, food, shelter—think of the many changes you have seen for yourself.

Many kinds of recreation today require new equipment. Our home appliances are far more versatile and complex. We have much more choice when we select a personal vehicle. Phenomenal advances have been made in communications and transportation, including modern mass transit systems, high speed air travel, and space travel.

Most of us are surrounded today, at our desks and in our homes, by so many things that we don't have time to use them! We are confounded to realize how many resources are tied up in the material objects we seem to accumulate without even trying.

Some of our resources are renewable: trees grow back if a forest is carefully managed over many years; crops can be raised year after year only if the soil is not depleted.

Other resources are non-renewable: when minerals are extracted they can not be replaced except perhaps over geological ages of time; when open space land is converted to urbanized development, it is almost impossible to recreate the original open space and natural values.

Some resources are interchangeable, too. In constructing homes we can choose from a variety of materials; we don't have to use those which are scarce. The same is true in choosing materials and fabrics for our clothing; we can select clothing and other merchandise which are produced with the least environmental damage. No doubt you can think of many examples with respect to foods and product packaging.

There is another alternative: to consume less and do without some of the non-essentials. It's too bad to see our resources wasted when we all recognize that many resources could be put to good use in helping our children and other people around us to a better way of life. Today we are seeing more public concern and joint action to conserve our natural resources and use them wisely—and an even greater effort by everyone is needed.

YOUR TOWN: HOW IT WORKS AND SURVIVES

> "Modern man seems to believe he can get everything he needs from the corner drug store. He doesn't understand that everything has a source in the land or sea, and that he must respect these sources."
>
> —Thor Heyerdahl

Where does everything in your town come from? Certainly not from the corner drug store or the super market or the department store—where then? Your town is composed of much more than people, businesses, and houses. Your town functions as a complex net of interacting systems. These systems, when they function properly, keep you informed, housed, clothed, and well fed.

The systems of a city are something like the systems of your body. If your body is not properly cared for it will not function as it should. In this section we'll explore further the life support systems of a city and the people in it.

Essential Products

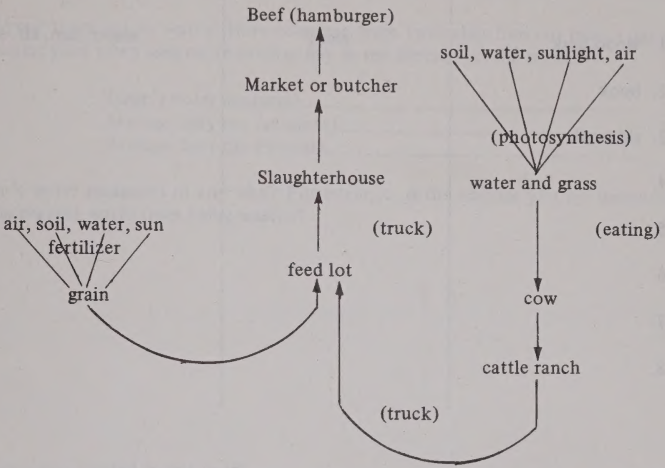
Using the chart, keep a week's record of all of the foods you eat. Compare your diet to that of the people in a country you previously studied. What are some of the reasons for the differences?

Types of Foods You Eat

	Meat and Fish	Dairy Products	Breads and Cereals	Fruits and Vegetables	Candy, Soft drinks, etc.
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					
Saturday					
Sunday					

Pick one of your favorite foods and trace back through all the steps it takes for that food product to get from the land to you. Find out exactly where the food product comes from. Does it come from far away? If so, how did it get to your town?

Sample of a food flow chart:



Beef (hamburger)
Market or butcher
Slaughterhouse
(truck)
feed lot
air, soil, water, sun
fertilizer
grain
soil, water, sunlight, air
(photosynthesis)
water and grass
(eating)
cow
cattle ranch
(truck)

Your food flow chart:

How many steps has your food product gone through?

Do any of your foods actually originate from within the city? ____________________

____

What land resources are necessary to provide the transportation for your food products? This gets fairly involved but it is interesting to discover how much you depend upon the earth.

Look around you in the classroom or in town. What non-living materials are present (such as wood, stone, plastic, etc.)? What are the sources of these materials? What basic ingredients go into the production of these sources?

Materials	Sources	Basic Ingredients
1. wood desk	trees	water, sun, air, soil
2. book		
3. sidewalk		
4.		
5.		
6.		
7.		
8.		

Pick an object which is made out of one of these non-living materials, such as a desk top or clothing, and trace all the steps it took to get the finished product to you from the original raw materials. Be sure to include the transportation and manufacturing steps that are involved.

Roughly speaking, how many people depend on the production and transportation of this product for their jobs and income? (A lot? a few?)

Water - Its supply and use

Water is a resource none of us can live without. Water has endless uses, and yet today we seem to be taking its availability for granted. As demands for water increase, we must utilize our water resources carefully since there is only so much available at any given time.

Where does your town get its water? Have someone from your class find out from your city government about how much water your town uses on an average day in the summer; in the winter.

Town's water source(s) ______________________________
Average daily use (summer)______________________________
Average daily use (winter)______________________________

Is your town's water measured in any way? For example, is the amount you use measured with a meter? If so, how does this prevent water from being wasted?

Is your town's water treated in any way? ______________________________

How is this done and what chemicals are used? Why?

What are the major uses of water in your town? Think not only about how families use the water but also about the industrial uses, etc.

Find out how much water your household uses in a day or month. You can figure out what the major uses of water are in your household by taking a few simple measurements. For example, a toilet uses about 7 gallons of water every time you flush it. Can you figure out how much water is used in:

1. the bath or shower ______________________________

2. the clothes washer ____________________
3. watering the garden ____________________
4. personal consumption ____________________
(drinking and cooking)

Does the water leave your household in the same condition as it came in? ____________________

How has it changed?

What happens to the waste water after it leaves your house?

Is there a sewage treatment plant in your town? If not, why not?

If the sewage is treated, what kind of treatment does it receive and where does it go after treatment? Locate this place on a map of your town.

The disposable environment?

A major problem today is the disposal of solid wastes. Not only do we have to worry about where to put our discarded cars and our aluminum, plastic, and glass containers; we must also concern ourselves with the depletion of the resources that go into making these products.

How and where does your town dispose of its garbage? Is this posing any problems for your town? What?

An interesting project is to figure out how much solid waste your household is producing per day. Using a bathroom scale, determine how many pounds of various types of solid wastes your household produces each day for a week.

Day	Cans and Metal (lbs.)	Paper (lbs.)	Plastic Products (lbs.)	Food Refuse (lbs.)	Glass (lbs.)
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					
Saturday					
Sunday					
	Total	Total	Total	Total	Total

Add the weekly totals of each type to discover the amount of waste your household produces in a week.

________ x 52 = ________

amount per week

amount used per year

Think about the kinds of waste and why they come into your house in the first place. Could your household reduce the amount of waste it produces?

Kinds of waste	Ways you can reduce waste

Do you think any of these "waste" materials could be reused? If so, which ones?

Materials which can be reused:

Of the materials being thrown away, which ones originate from resources which can be restored by man? Refer back to the table you made of materials, sources, and basic ingredients on Page 44.

Resources which can be restored by man:

1.
2.
3.
4.
5.

How are these sources renewed? To find out, assign members of your class to contact the local agencies which deal with the land and its resources.

Of the materials being thrown away, which ones originate from resources which cannot be restored by man? Refer back to the table you made of materials, sources, and basic ingredients.

Resources which cannot be restored by man:

1.
2.
3.
4.
5.

As we slowly use up these resources which cannot be restored by man, what do you suppose is going to happen? Use a poem, a story, or a sketch to communicate what you think will happen.

Energy: critical needs or excessive wants?

In our "all electric world" we often take for granted the electricity we use for light, heat, and power. Most electrical power is generated by the combustion of stored fossil fuels, the controlled reaction of radioactive materials, and utilization of the potential energy present in falling water. Try to find out what effects the construction of new power facilities may have on your environment.

What is your town's source of electrical energy? ____________________
How is it produced?

How do you use electrical energy in your day-to-day life? For one day, keep track of the times you use electricity. Also list the purpose for which you used this electricity.

My daily use of electricity:

use	Purpose
example: 1. electrical can opener	1. open dog food can

How many of these uses could you do without and still lead a comfortable life?

There is currently a great concern in our country over power shortages. Can you think of any way to eliminate this shortage without producing more electricity and building more power dams; How?

How is your home heated?

What is the original source of this energy?

Industrial effects on your town

One of the main reasons for people moving to the cities in this century has been the location of jobs. People in the city depend upon their job for an income which will buy food produced in the rural area as well as other goods and services. Both good and bad effects result from an industry locating in a town. Jobs are created and income flows in the town, but negative effects can also occur.

What is the main industry (or industries) in your town?

About how many people in town depend on this industry for their living?

How might the climate affect the types of industries located in your town and their operations?

Think of the effects (both good and bad) that this industry has on:

land
air
animals
water
the town
people
you

Give some examples:

	Good	Bad
land		
air		
animals		
town		
people		
you		

Teacher's Page

Is pollution everywhere, or do people just make it sound that way? You can decide for yourself whether pollution is a problem in your community. Start sniffing, and listening, and looking carefully around you. Some of us have grown up with or become accustomed to objectionable odors, excessive noises, and offensive sights, but now these environmental conditions have become "pollution."

You can "feel" your environment, too. Do you notice the pavement under your feet? Can you feel the breeze? Do you prefer a city mall or a county park? We need to remember that man-made as well as natural environments can be pleasant.

When your senses tell you "pollution!", the time has come to track down the sources. The causes of pollution are usually complex. Factories, buildings, vehicles, sewage systems, power plants, resource extraction processes, towns themselves—all exist to produce the many things that people need and want. Generally speaking, there are several ways to reduce the pollution that results. Many conservation and other groups which offer solutions to our environmental problems have received nationwide publicity, so you can probably list many of their ideas, and your own as well.

Pollution occurs in agricultural and wilderness areas as well as towns. Some farm practices and development trends must be modified to protect these areas. Environmental changes in non-urban areas often occur more slowly, but over a period of time they reduce the amount and productivity of our Nation's lands and resources that are available to promote good health and enjoyment for everyone.

To recognize environmental pollution, it helps to understand ecology—the inter-relationships among living things and non-living things in the environment. Ecological relationships exist everywhere—deep in the city or out where the country is filled with plants and wildlife. Most of us need more knowledge about ecology. Such knowledge can help us determine standards for cleaner water and air, for rational land use, and for protection of all living things.

Institutions such as businesses and governments pollute, but we as individuals cause pollution, too. We should keep in mind that modern technology has brought man many benefits in terms of health, comfort, education, and communication. We do not want to throw these advantages away. But we should weigh carefully the pros and cons of complex inventions and development. We should evaluate our own demands and habits thoughtfully, and make personal choices which favor a healthier environment.

PROBLEMS IN YOUR TOWN: AIR, NOISE, WATER

Why problems occur

Pollution—Where does it come from and why does it occur? You can answer these questions for yourself by looking at the processes which various materials go through to become finished products. The production of goods and services for people usually has both good and bad effects. Bad effects occur in the form of pollution and good effects in the form of desirable products and employment. In an earlier part of this guide (Page 43), you traced the steps it takes for various materials to reach you as finished products. Now you can take a closer look at this process.

Think of a product that you use often. On the following pages, detail the steps it takes from: raw material → production → finished product → use → disposal. For each step decide what the good and bad effects are. Be sure to look at the processes involved in each step of production and also what happens to the product after it is used. This may take some research.

The product is ____

Raw Materials:

List:

What happens to the raw materials before they go through the production process?

good effects:

bad effects:

Steps in production:

List:

What effect does each of these steps have?

good effects:

bad effects:

Use of finished product:

What do you do with the product after you get it?

What effect do these uses have?

good effects:

bad effects:

Steps in disposing of waste from product or wornout products:

List:

What effects does disposing of this product or its wastes have?

good effects:

bad effects:

Air

Observe your city from a hill or tall building. What are the sources of the pollution you can see, hear, or smell?

Sources	Type of Pollution
example: incinerator–from burning waste materials	smoke in air

Locate and describe the source and type of pollution on a map of your city. Does this pollution occur near any residential areas? ____________________ If so, how might it affect the people who live there?

Notice the days when your city's air is dirtiest; find out what the weather pattern is on these days (high or low pressure, velocity, wind). Find out from the weather bureau in your area if inversion conditions ever exist. (Inversion conditions occur when a warm layer of air is trapped between two cooler layers of air.) This prevents the atmosphere from mixing, and air pollution could be more serious on days like this. See the diagram below.

Normal conditions
coldest
cold
cooler
Air
cool
warm
warmest
______________ ground

Inversion conditions
coldest
cold
cooler
cool
____
warm
Inversion Layer
warmer
____
cooler
cool
warm
warmest
________________ ground

From your exploration of the weather do you see any relation between days of bad air pollution and the weather patterns over your town? ______________________ If so, what is this relationship?

Do you think smoke can be emitted in large quantities on any day without causing an air pollution problem or should the daily weather patterns be considered before allowing smoke emissions? Why or why not?

A lot is said about how bad air pollution is and what a major problem it is, but have you figured out how it affects your life? Here are some questions and activities your class may want to try to help you learn more about the effects of air pollution.

At home or at school, designate as a dust indicator a table or similar surface. Leave it undisturbed for three days with a white handkerchief on it. After three days note the dust accumulation on the handkerchief and look at it under a hand lens or other magnifier. What does it look and feel like?

Do you have any idea where some of the particles came from?

Notice what accumulates on a clean car after it is left out overnight. Keeping this in mind, how do you think dirty air affects your life, or does it?

What would this air do to your clean clothes if they were hung outside to dry?

What might this air do to your lungs?

Now that you've thought about what dirty air does to man, what might this air do to affect other animals?

How do you think dirty air can affect plants?

How do you think air pollution is measured? You can learn about air pollution standards from an official of the local air pollution control office which monitors your town.

Use a poem, cinquain, sketch, story or anything else you wish to express how you feel about the air in your town.

If there is an air pollution problem in your town, set up a class project designed to help solve this problem. The use of games with students playing the role of various community groups is an exciting way to learn more about solving a community problem.

Here is an example of a simulation game which your class might want to try:

The Problem:

An industry in town is putting out great quantities of black smoke as a result of the burning of its waste products. The town is located in a valley which means the smoke is not blown away easily. A group in town has formed to stop pollution of the air. This group is complaining to the town council about the smoke problem.

The industry says it cannot afford to change its method of waste disposal. Other people in town oppose the control of the smoke because they feel it will discourage industry from moving to their town. They say this would prevent economic development.

The Players:

1. Town Council—This is the town's governing body which will decide whether the smoke pollution will be stopped. The purpose of the other groups is to persuade this council through their representative that their position is correct.
2. Industry Representatives—This group represents the industry which is causing the smoke pollution. They are naturally concerned with their interests and want to keep their profits at a maximum. However, they are interested in public opinion and may respond to public pressure. The group claims that their economic development will be harmed if strong controls on smoke emissions become law.
3. Citizens for Clean Air—This group is determined to solve the smoke pollution problem as soon as possible. Its members believe that a clean environment is more important than a profitable industry in town. The group also believes that the waste product being burned could be put to a valuable use. Most people in this group do not depend on the industry for their jobs.
4. Citizens for Economic Development—This group is composed of businessmen and also people who work for the industry causing the smoke pollution. They are siding with the industrial group since they are concerned with the town's economy. However, this group realizes that environmental quality is important and might seek a slow, gradual solution to the problem so that the industry is not hurt.

Procedure:

Divide the class into the various groups. Each group should meet and discuss what it wants the town council to do about the problem, and what the group thinks is needed to make this a better place to live. The ideas should be based upon some research into the problem, not just personal opinion. Elect a spokesman for each group to present its "case" to the town council when the class meets as a whole again.

The town council should elect one of its members to be in charge of the meeting. After listening to the representatives from the different organizations the town council should come up with a list of priorities—a list of what it is going to act upon first, second, etc. Your class may wish to invite a member of the real town council to meet with you and discuss your ideas.

Conclusions:

What solutions to the smoke pollution problem did the members of your class think were the best?

What is your own opinion about the smoke pollution problem above?

If your class found the smoke pollution problem interesting, you may want to find out if there are groups in your town discussing or working together on a major problem concerning land use, air pollution, noise pollution or water pollution. Perhaps someone in your family is interested in pollution problems. Also, your local newspaper probably has articles on major problems in your town.

List your town's major problems:

Which of these problems is the most serious right now?

What persons or groups are involved in this serious problem?

The class may wish to invite someone to discuss this problem. Think about the ways members of your class might help solve this problem and discuss your ideas with your guest.

List several ways you can help solve this problem:

Recall what sounds were heard in the first part of the guide, Page 17. When and where were the sounds the loudest and the most common?

Look again at the map your class made on population density (Page 35). How does the location of loud sounds compare to the parts of your town which are most crowded?

How do these locations compare with those from which the air and water pollution in your community are coming?

Is there any relationship between water and air pollution and noise pollution?

If you think so, what is the relationship?

Could noise pollution have a bad effect on people? How?

Have you ever heard a noise so loud you couldn't stand it? What caused the noise, and what did you do?

What are the regulations controlling noise in your town?

Do you know how noise is measured? Can someone in your town help you learn about this? Record what you find out:

List some animals, birds and fish you know about. How much noise can they tolerate? Is it more or less than man can tolerate? What activities of these animals do loud noises disturb?

As a class choose one object with an annoying noise and try to quiet it.

Object:

Method used to quiet noise:

Was it successful? Why or why not?

What object would you like to quiet the most now?

How would you go about doing this?

Describe by either a sketch or a poem why you find this noise annoying.

What river or creek runs through or near your town? ________________

Where does it start? If you do not know, look at a state map or a map of the United States.

What happens to this river or creek as it flows to join a larger body of water or the sea?

Where are most of the towns located on the river or creek: near the beginning or where it joins a larger body of water?

What do you think will happen to this river or creek as it runs through the town? What materials will probably be added to it?

What materials will probably be taken away?

With your class, travel to a place along the river or creek upstream from your town.

With one word describe how the river smells. ______________________________
With two words describe how it looks. ______________________________
With three words describe how it feels. ______________________________
With two words describe how it tastes (if safe). ______________________________
With one word describe how it sounds. ______________________________

What materials do you see in and along the water which don't really belong there? For example, are there any old tires or tin cans? What else?

List of materials found:

What can you do to help correct this problem?

What plants and animals do you find living in the water?

Plants: name, describe, or sketch	Location (edge, middle, etc.)

Animals: name, describe or sketch	Location (edge, middle, etc.)

Animals that live in the water cannot stand too much acid or alkali in the water. Using a pH kit, test the water to determine how acidic or alkaline it is. Follow the directions found in the kit.

What is the pH of the water tested? ______________________________

Looking at the chart below, what animals would most likely be found here?

What plants would be found here?

pH Ranges that support aquatic animal and plant life

Most acidic	Neutral	Most alkaline
1	7	14

6.5-7.5
largest variety
of animals, trout,
mayfly, stonefly,
caddis fly

7.0- - - - -9.0
snails, clams

6.5- - - - - -8.5
bass, crappie

6.0- - - - - - - -9.0
carp, suckers, catfish,
some insects

6.5- - - - - - - - - - - - -12.0
plants (algae, rooted, etc.)

1.0- -bacteria- -13.0

All life needs oxygen in order to live. Pollution reduces the amount of oxygen in the water. So do water plants. Using the pH kit, test for the amount of usable oxygen present in the water. Follow the directions given in the kit.

What is the water's oxygen content?________________________

Looking at the chart below, how much life can this amount of oxygen support? ________________

Useable oxygen in ppm reading	Variety of life
below 5	very little life can survive
above 5	large variety of life

Now travel to a place on the river just below the town and examine the water. Using all your senses describe the water in the same manner as you did upstream.

Do you find the same type of materials, such as cans and paper, in and along the river as you found upstream?

List the materials you find here:

What plants and animals do you find living in this part of the river?

Plants: name or describe	Location (edge, middle, etc.)

Animals: name or describe	Location (edge, middle, etc.)

What is the pH of the water here? ____________________

Looking at the previous chart, what animals would most likely be found here?

What plants would be found here? ____________________

What is the oxygen content of the water here? ____________________

Looking at the previous page, how much life can this amount of oxygen support? ______________

Is there any difference between the water above and below your town? __________ , If so, what and why?

Where did you like the river the best? _______________ Why?

Make a drawing of what the river would look like if it ran through a hundred towns just like yours. Would you like to live in a town along this river?

After finding out about your town, its life support systems, and its problems, describe how you would most like your town to change and why. Use a sketch, a poem, a story, or anything else you wish.

SECTION III

Nature's Ecosystem

Even before we step outdoors, there is much to be learned about ecological inter-relationships. Start with the principle that every living organism is related to the organisms (plants and animals) and the basic substances (sunlight, air, water, and soil) in its environment.

We all know more than we think we do about living organisms, so we can recognize their role in ecology by asking some questions about inter-relationships. To understand more, use the beaver as an example.

What are the beaver's roles in Nature?
Where is the beaver's home?
What organisms and substances in its environment does the beaver depend upon for survival? How does it use these organisms and substances?
What effects does the beaver have on other organisms and substances?
What organisms and substances in this environment depend upon the beaver? How do these organisms and substances use it?
What effects do other organisms and substances have on the beaver?
Where does the beaver fit into the food cycle in its environment?
How does the beaver reproduce?
How is the beaver affected by climatic conditions?
What adaptations has the beaver developed to suit itself to this environment?

Even though it will take some time, you can begin to see the variety of inter-relationships which occur in Nature if you will select one or more plants or animals you are familiar with and utilize these general questions again. Don't forget that one "organism" found in many environments is Man!

In studying the ecological role of several organisms, you will probably begin to notice that, while different organisms are the components of ecosystems in different parts of the world, certain types of inter-relationships appear in all or most of them. Also, some ecosystems enjoy a much greater abundance of organisms that others, and you can try to identify factors in each ecosystem which influence the number and variety of organisms. You can also try to draw some conclusions about the stability or fragility of ecosystems with certain environmental conditions and a greater or smaller variety of organisms. "Fundamentals of Ecology," by Eugene P. Odum, is an excellent book for learning about basic ecology. These ecological principles are applicable to all the natural resources issues and decisions we face today.

Did you notice that "ecology" questions didn't ask about "good effects" or "bad effects"? That is because the ecological inter-relationships in a natural ecosystem generally create a natural balance. Certain climatic and geological conditions and certain organisms may have adverse effects on the dominant components of an ecosystem on a short-term basis, but over the long run, it appears that systems of ecological relationships regulate themselves. That is one reason we must assure that man's actions harmonize as much as possible with the ecological inter-relationships in his environment, so that he will not upset this natural balance.

INTER-RELATIONSHIPS IN NATURE

Before you go outdoors, investigate some basic ideas about the natural environment.

BASIC NEEDS

Every day we work, we play, we eat, and we rest. To do these activities, we must use resources that come from our environment. Think about the things you use every day.

To live, I need:

1)
2)
3)
4)
5)
6)
7)
8)
9)
10)

It would be interesting to compare your list with lists from other members of your class. Discuss why you need the things on your list. Could you live without some of these things? Try to separate the needs that are really essential from the things that are just nice to have.

To live, I need these essential things:

Choose one of these essential things to think more about. Where did it come from? What are its basic ingredients?

Choose an animal you are interested in. It may be a pet, an animal you saw in the zoo, or one you have studied.______________This animal has basic needs, too. List the essential things it needs to live:

Which essential things from your two lists are found in Nature?

Which are Man-made?

Found in Nature	Man-made

Picture yourself or a favorite animal surrounded by the essential things in his environment. Use a poem, a sketch, a story, or anything you wish to show this.

THE WEB OF LIFE

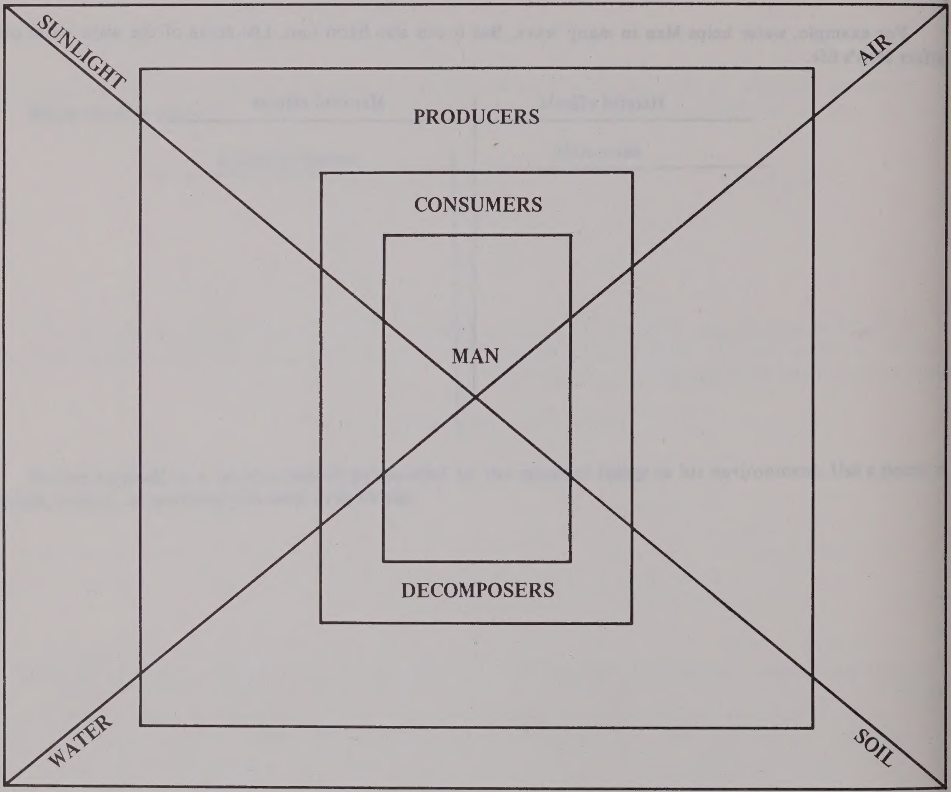
Every living thing depends upon its environment for survival. Man, animals, plants, sunlight, water, air, and soil all exist in the world. But you really can't study each one separately, because they are all related to each other.

For example, water helps Man in many ways. But it can also harm him. List some of the ways water can affect Man's life.

Helpful effects	Harmful effects

The inter-relatedness of all living things in the environment is called the Web of Life.

THE WEB OF LIFE


SUNLIGHT
AIR
PRODUCERS
CONSUMERS
MAN
DECOMPOSERS
WATER
SOIL

The Web of Life describes everything that exists in Nature. When you think of Nature, do you include Man?__________ In the diagram Man is shown in the center of the Web of Life. Must he always be in the center? Choose something in Nature and think of ways in which Man can affect it.

Object in Nature: ______________________________

The possible effects of Man on this object are:

Most producers of raw materials are green plants and trees. They use sunlight, air, water, and soil to produce food for animals. List some producers. Which ones are usually found in your town? Which ones are usually found in the country and in the woods?

Producers (name or sketch)	Place usually found

Most consumers are animals, large or small. Some consumers depend for food mainly upon plants. These consumers are called by the special name herbivores. List some herbivores. If you can, name the plants they depend on for food. Do some herbivores depend on more than one plant?

Consumers-Herbivores (name or sketch)	Plants consumed for food

Some consumers depend for food mainly upon other animals. These consumers are called carnivores. List some carnivores. If you can, name one or more animals they depend upon for food.

Consumers-Carnivores (name or sketch)	Other animals consumed

Did you discover that some consumers eat both plants and animals? ______________ These consumers are called omnivores. List some omnivores. If you can, name the plants and animals they depend upon for food.

Consumers-Omnivores (name or sketch)	Plants and animals consumed

Do you think Man is a consumer? ______________ If so, is Man an herbivore, carnivore, or omnivore? ______________ Do all the people you know or have read about eat the same kinds of food? Describe the foods your family eats and the reasons for eating them.

Most decomposers are bacteria and fungi. Bacteria are microscopic animals, and fungi are plants. Decomposers break down the decaying parts of plants and animals and return them to the soil where they can contribute to new growth. Try to explain why you think decomposers are important in the Web of Life.

Think about sunlight, air, water, and soil. They are basic ingredients in the Web of Life. Are they living things?_______________ Why, or why not?

Choose a favorite plant. __________ Why does it need sunlight, air, water, and soil?

Choose a favorite animal, large or small. _____________ Why does it need sunlight, air, water, and soil?

Now think about yourself. Does Man need sunlight, air, water, and soil? _______________ Why, or why not?

Earlier (Page 72) you tried to name things in your environment which are essential to your life. If you would like to add or subtract from the list you made, try again to list your basic needs.

To live, I need these essential things:

What would happen if one of these essential things was removed from your environment? Use a poem, sketch, story, or anything you wish to show how the parts of the Web of Life are important to you.

When you go into the outdoors, try to remember the Web of Life and its inter-relationships, and see what examples of these inter-relationships you can observe in Nature.

Whenever you go into a natural environment, try and arrange for a little time to spend by yourself in a place you especially enjoy. You can learn a lot about the outdoors from the knowledge and enthusiasm of other people, but there is a particular pleasure in exploring and discovering some of Nature's secrets and surprises for yourself.

Sunlight adds a large measure of beauty to the outdoors. Watch the long shapes which sunlight creates in the trees or the fields. See it glisten through the leaves with a luminous sheen, with a color all its own. Notice the glowing life it brings to the green and gold, to all of Nature's colors. Notice, too, Nature's patterns and textures in leaves and petals, branches and waving grasses.

What can you feel here? The breeze, for one thing. But can you hear it, too? There are many effects in Nature that seem, somehow, to play on all our sensations, of touch, of hearing, of taste, in a subtle way which may bring peace and calm to our whole being. The crispness of winter's frosty air, the crackle of brittle autumn leaves under foot, the earthy springtime odor awakening in a dark, furrowed tree trunk, the moist, spongy carpet of the earth itself, teeming with newborn life—all the elements of Nature may appeal to our senses. Nothing can soothe us more than the gentle splash and gurgle of a clear stream, slowly making its way among the smooth stones. And when we hear the birds, answering one another from tree tops near and far, we feel as though it has been this way every spring morning for a million years.

Maybe you can put your knowledge of rhyme and meter to work and communicate your own enjoyment of a particular place to a special friend through poetry. Somehow, Nature, at any time of year, brings to us a calmer perspective and a sense of renewal.

IN THE NATURAL ENVIRONMENT

Using your senses

Look all around you.
Listen to the sounds—the quiet.
Touch the earth—the trees.
Sniff—there are lots of things to smell.
What do you see? What do you hear? What do you smell?
Write a cinquain about being here:

____

__________ __________

__________ __________ __________

__________ __________ __________ __________

____

Use a sketch or picture to show what you like best about this place. Some aspects of Nature (sound, odor) cannot be sketched. If you cannot sketch it, decide what type of communication you could use to share with others how you feel about this place.

On the following charts, list natural and Man-made things you see, hear, and smell.

Things I see: (name or sketch)

Natural	Man-made

Things I hear: (name or sketch)

Natural	Man-made

Things I smell: (name or sketch)

Natural	Man-made

Try to imagine how this place looked 100, 1,000, and 10,000 years ago. What things do you suppose were different? Make some sketches showing how you think this place looked in the past.

Do you think Nature or Man has caused the most changes over these years? List some changes you think have occurred or are occurring now.

Changes caused by Nature	Changes caused by Man

How do you think this place will look 100, 1,000 and 10,000 years from now? Make some sketches showing how you think this place will look in the future.

Who owns this land?

How is this land being used?

How do you think this land will be used in the future?

Who will decide how it will be used?

My favorite thing here is ____________________
Because

The things I like least about the place is ____________________
Because

Pretend this land is yours; you can change the things you don't like, and leave the things you like the way they are. How will you decide?

How would you like to see this land used? Use a sketch, a poem, a short story, or anything else you wish.

Soil is a basic and vital substance composed of tiny rock particles, air, water, and decaying organic material. Soil builds up very slowly over the centuries. Living organisms depend on it for nutrients, minerals, moisture, and physical support.

You have probably noticed that soils differ in depth, color, and texture from one place to another. In some soils clay predominates; in others, sand or silt. Geological conditions, topographic features, climate, water sources, and the composition of the plant and animal community all affect the condition and composition of the soil. Soil problems differ from place to place, too.

Soil is a valuable resource we cannot afford to lose, yet every year millions of tons are lost to rivers and streams as sediment. In mountainous areas, the soil is subject to serious landslides and spring flooding because of excessive rainfall or the melting of snow. The soil needs a stable ground cover, a good variety of roots and vegetation to hold it. Once erosion begins, whether Man-made or natural, it is difficult to re-establish vegetation. The soil becomes thinner as subsequent erosion takes its toll and may become unfit for plants and animal life. In some places, urban development has taken place on delicately-balanced slopes, and dangerous landslides have followed. In other places development has taken rich cropland soils out of production.

In grass and pasturelands soil may wash away, too. The roots of many grasses grow 2 feet deep or more, but overgrazing can denude the lands just the same. In the American Southwest, where many chaparral or desert-like regions are grazed, soils are characterized by very high sand content and little moisture. Vegetation is sparse and spreads itself at intervals to make maximum use of the available moisture. As a result, a minimum of plant and animal life is returned to the soil as organic matter. Rains seldom come. When they do, a flash-flood may occur if the sandy soil cannot hold the moisture. Some desert areas may be swept bare of soil by wind erosion, too.

In areas of fertile cropland, soil nutrients can be depleted if rotation of crops is not practiced. A thick, fertile soil cannot afford to lose its valuable store of minerals, nutrients, and moisture to the same plants year after year. A variety of plants will take different amounts and kinds of these elements from the soil. As these plants and the variety of animal life associated with them die and decay, they will return rich organic matter to the soil so that nutrients and minerlas can be recycled.

The soil in river and ocean beds is important, too. Many aquatic animals have suckers, tubes, and other appendages which permit them to cling to the waterbed or burrow into the soil. If a layer of sludge or sediment is deposited over their habitat, these animals will probably float at the mercy of the currents, unable to adapt rapidly to an altered environment.

Wherever you're standing, look down around your feet.
What's there?
Is anything growing there?
Move to to a place where you can pick up a handful of soil without harming any living thing.
Look closely. What is the soil made of?

Feel it. How does it feel? Is it gritty, smooth, or sticky?
Smell it. How does it smell?

Take a short walk, do these same things on another spot, and ask yourself the above questions again.

How are the soils in the two places different? How are they alike?

Differences	Similarities

Why do you think soil is important in Nature?

THE EFFECTS OF CLIMATE ON SOIL

When you looked at the soil, did you see any pieces of rock? Over a period of time rocks are broken down by weather to form new soils. Think about the climate or weather in your area:

1. What variations of temperature do you have during the year?
2. Is there a lot of rain? Is there a lot of snow?
3. Does the rain come evenly throughout the year, or does the area receive heavy rains and occasional floods?
4. Are there strong winds?
5. How does weather affect the speed with which rocks break down in your area?
6. How does weather affect the types of plants and animals that can live in your area?

ORGANIC MATTER

When plants and animals die and decay, they contribute organic matter to form new soil. The waste materials from living plants and animals also become organic matter for the soil.

Choose a plant big enough for you to inspect it closely. What will it contribute to the organic matter?

Plant (name or sketch)	Contribution

Choose any animal you have seen or suspect to live in this area. How will it contribute to the organic matter?

Animal (name or sketch)	Contribution

What about Man? What contribution do you and your activities make to the organic matter?

Man	Contribution

TOPOGRAPHY

Topography is the slope of the land; it may be steep and rugged, gentle and rolling, or any combination. Lakes, rivers, and mountains are included in the topography of an area.

How does the topography here influence water runoff and erosion?

How do runoff and erosion affect the soil?

Look for an example of water runoff or erosion. Use a sketch, cinquain, poem, or anything you wish to show the way topography can affect runoff or erosion.

How does the topography affect the types of plant and animal life than can survive here? How does this affect the soil?

SAMPLING

Perhaps you've wondered what lives in this area beside the plants and animals that you can see. Many smaller organisms, including lichens, fungi, and bacteria, are members of the living soil community.

To discover how all of the living organisms fit within the Web of Life is the job of the ecologist. He studies all living members of a particular area in detail. He tries to understand how they are inter-related and dependent upon each other.

Since the ecologist cannot look in detail at all of the large area, he studies small units of land within the area. This is called sampling. From the information he collects, he can make estimates of what is living in the entire area and what inter-relationships are occurring.

When you do a sample, try, like the ecologist, to understand how the living organisms you see are inter-related.

Equipment Needed:
- hand lens
- hand spade
- plastic containers with lid for collecting study specimens
- box lid or sheets of paper for inspection of soil organisms.

For your sample, mark off a 12" square section with sticks or rocks. Carefully inspect all you see on the surface of the plot and record what you find on the following chart.

SURFACE FINDINGS

Animal (name or sketch)	Number

Plant (name or sketch)	Number

Examine the plot to a depth of 2" or 3" by digging up individual clumps of soil. Gently shake the soil from the plant roots into a box lid or on a piece of paper. Record the life you find in each upturned piece of sod. After your investigation, be sure to replace the sod clumps in their original places.

SUBSURFACE FINDINGS

Animal (name or sketch)	Number

Plant (name or sketch)	Number

Decomposers break down the organic matter in the soil. Can you see the work of decomposers in your soil samples? Describe what you see.

How do you think decomposition of organic matter affects the soil?

How do you think the decaying of plant roots affects the soil?

How do you think the soil is affected by the burrowing of earthworms and other animals?

How is the soil beneficial to the plants and animals living here?

How is the soil beneficial to you?

Use a poem, a cinquain, a sketch, or a story to describe all the life you imagine is going on in the soil.

Man needs water for life, and so does every living thing. It is interesting to think how many functions water has, and how water's functions in the natural environment compare with those in a Man-made environment.

For both plants and animals, water is the essential medium in which basic life processes—reproduction, respiration, food manufacture and digestion, growth, and excretion—take place. This is true for man as well; in fact, the major portion of the human body is water.

Many organisms use water for transport. In both marine and freshwater environments, currents carry plants and animals hundreds of miles. Rivers transport seeds, and provide a highway for fish and a place for some fish to spawn. In Man's society, people, travel, and freight are hauled down the river and across the oceans.

Water is also a cooling agent. Temperatures in water change much more slowly than on land. Water provides favorable temperatures for the reproduction and growth of many species. It also cools and lends moisture to the air, thus protecting plants and animals in the terrestrial environment from intolerable levels of heat and aridity. Man feels the cooling effects of water, too. In many parts of the world, human settlements are located near water to take advantage of this. In modern industry, water is used as a coolant in many manufacturing processes. Water which is discharged back into rivers or oceans at a higher temperature may have adverse effects on organisms accustomed to cooler waters; thus, thermal pollution may result. Nowadays, water is an important part of the air conditioning that is used so much in our cities.

Water also provides protection for many living organisms. For many plants and animals in Nature, the water is their home. Water prevents excessive heat, air, and sometimes foreign matter from reaching them. Its fluid character and depth permit some aquatic animals to hide from or escape their would-be captors. It can also protect a natural area from wildfire. Water helps protect Man and his home from fire, too. It can also serve as a shock absorber to soften our landing if we fall, to cushion mechanical processes, and to reduce the effects of some geological disturbances.

Water functions in many other ways in both the natural and the Man-made world. Man uses enormous quantities of water in many ways, every day. What other roles does water play in our lives?

Water

How would you define water?

How does it look?
How does it sound?
How does it feel?
How does it smell?
How does it taste?
Use a poem, a cinquain, a sketch, or a story to describe how you feel about the water in this place.

What kinds of plants and animals live in this water? Using your hands, a dip net, and a hand lens, investigate in and around the water. Remember to put back where you found it anything you study.

On the following page, list the water life you find.

FINDINGS

Animal (name or sketch)	Number

Plants (name or sketch)	Number

Miscellaneous findings	Number

THE WATER HABITAT

Think about the kinds of animals you have observed. What part of the water and its surroundings does each animal choose for its habitat, or home? Select several different kinds of animals. Describe their habitats and try to explain why each animal lives where it does.

Animal (name or sketch)	Habitat	Explanation for habitat

Do you think there are other kinds of animals in and near the water that you cannot see easily? Where are their habitats? Why do you think they live where they do?;

Look again at the plants you have observed. Do you find different kinds of plants in different areas of the water? Describe some of the differences you see and try to explain them.

Do some of the plants and animals here depend on each other? In what ways? Describe several examples of interdependence you see, and try to explain hem.

How do you think the animals here affect the water?

Do plants affect the water, too? In what ways?

Look carefully around the edge of this body of water. Is the water level high or low? ____________ How can you tell?

Low water can have important effects on the lives of plants and animals. Try to think of several examples.

Name or sketch	Effects of low water

High water can have very important effects on plants and animals, too. What do you think they are?

THE HYDROLOGIC CYCLE

The water supply here comes from the hydrologic cycle. This cycle is a never-ending process. Water is carried from the ocean through the atmosphere. It comes to the land, then to the rivers, and then back to the ocean.

The massing of air over the ocean collects water or moisture through evaporation. As these clouds move over the land, they rise higher. There they are cooled, and moisture is returned to the land in the form of dew, rain, hail, sleet, and snow. Rivers then carry the water back to the ocean where the cycle starts again.

Make a drawing that will help you understand the hydrologic cycle.

Do you think the hydrologic cycle is important to Man? Why or why not?

Make a rough map of the body of water here. Can you see any tributaries (springs, rivers, and streams pouring water into this body) which should be added to the map? You may want to include the human settlements and Man-made facilities around this water which affect it. If you would like, show some of the fish, plants, and anything else about the water that interests you.

Using your map, try to explain something about the hydrologic cycle. What stages of the cycle can be demonstrated in this place?

MAN'S USE OF WATER:

How is Man using this place? Think of as many ways as you can.

Do you think Man's activities affect the water here? How?

How does your visit affect the water and the plant and animal life here?

What do you think the best use would be for this place? If you wish, describe more than one use.

Would any changes be necessary to make the best possible use of this place.? What would you have to do to make these changes?

Do you think this water is pure enough to produce fish safe for eating?

Is it pure enough for you to swim here?

Is it pure enough for you to drink?

With jars or bottles, you can take back water samples for testing. Can you think of someone in your school or community who can test them?

If the water samples can be tested, make a record of the results.

If it is possible, arrange for your class to visit the water filtration plant and sewage plant for your community.

Plants play a unique role in the environment because they synthesize the energy upon which the other organisms rely. These organisms include not only Man and other animals, but the decomposers (bacteria and fungi) as well.

A quick review of the photosynthetic process by which plants manufacture food may be helpful. In photosynthesis, plants combine water from the soil, carbon dioxide from the air, and radiant energy from the sun to produce a food sugar substance. This process requires the presence of chlorophyll. The food substance takes the form of seeds, nuts, and fruits, which are important food sources for animals. Oxygen and excess heat are also given off during this process.

At each subsequent level in the food chain, a consumer or decomposer obtains energy in the form of minerals, nutrients, and water from the food it consumes. But since some of this energy is released through respiration and excess heat, some energy is lost to the atmosphere (from which it came) at each level. Since some energy is lost at every stage, the earth must produce a greater mass weight of plants than is necessary to support the energy needs of consumers and decomposers in the food chain. Scientists are using several methods to determine the amount of energy produced by certain plants. They know that cropland can be more productive if it is used for several crops on a year-round basis without permanently depleting the nutrients, minerals, and water from the soil. In natural settings, a variety of plants is usually better than just a few species. A variety of plants can combine the sun's energy with carbon dioxide and available moisture at different seasons of the year to produce more total energy.

Plants

Look at the plants all around you. How many kinds of plants would you guess there are here?

What colors are the different plants that you see? Which do you like best? Why?

The colors I see are:

The colors I like best are:

Because:

Sniff some of the plants. Try to find some that smell differently and describe their odors.

Plant (name or sketch)	Description of odor

How do the different plants feel to your touch? Find some that have leaves, petals, fruits, or stems that are unusual to touch. Describe how they feel.

Plant (name or sketch)	How it feels to touch

What kinds of plants do you find here? List them and tell why you think they are important or useful.

Plant	Importance or use

Think about the most important plants in this place. Did Man plant them, or were they introduced to this place naturally? If they were introduced naturally, how do you think they got here in the first place?

Most plants reproduce from seeds. Look closely at several plants. Where is the seed in each plant found? What is Nature's way of planting the seed?

Plant (name or sketch)	Location of seed	How seed is planted

Plants have many different kinds of roots. Examine several roots, sharing them with the class so that you do not pull up too many and disturb the environment unnecessarily. How do roots help each plant to live and grow? Are all roots the same in size and appearance? If not, how are they different?

How do the changing seasons affect the plants living in this area?

In winter?

In spring?

In summer?

In fall?

How has Nature affected the life and growth of the plants in this place? Animals, different kinds of weather, and different water conditions have possible effects. How has Man affected the plants living here? Man may use them for food, for manufactured products, and for enjoyment. List specific examples for natural and human influences on plants.

Natural influences	Influences of Man

In the previous chart, look again at the effects of Nature and Man on plants.

Which effects do you think are beneficial or good effects? Why?

Which effects do you think are harmful? Why?

How are the plants here related to each other? Are some plants dependent upon others? You may have to look very closely. You may also have to use your imagination. List several ways plants can be important to each other.

How are the plants important to the animals living here? Look closely so you will notice small animals, too. Try to identify several sets of inter-relationships between plants and animals.

Plant	Animal	How plant is important to this animal

Are the plants here important to you? If they are, see how many reasons you can list:

Are the plants in this place like the plants in your yard at home? Are they like the plants in your schoolyard? Discuss how they are alike, and how they are different.

Choose a plant you like and try writing a cinquain to describe it.

____

__________ __________

__________ __________ __________

__________ __________ __________ __________

____

Think of the many different kinds of environments in which plants and animals are found. There must be some factors which limit where each of these organisms can live. Some possible limiting factors are temperature, light conditions, water conditions, content of atmospheric gases, availability of nutrients and minerals, soil conditions, fire conditions, and currents and pressures. For any specific organism, certain limiting factors are more critical than others. Also, changes in limiting factors may or may not be critical, depending on whether a terrestrial, marine, or freshwater environment is involved.

Every species has its own minimum requirements. The availability of water, nutrients, temperature, and other limiting factors helps determine where each species will be found. At the same time, each species has tolerance levels for other factors and will be found only where these levels are not exceeded. Some plants and animals, of course, have a wider range of tolerance; they may be found over a broader geographical area and may also be more resistant to environmental changes. In addition, many species are found under a variety of environmental conditions because these species have been able to adapt or adjust their tolerance levels.

If you are trying to identify the factors which limit a particular species, it may be easiest at the margin or edge of its geographical range. Then, if environmental conditions change—for example, an extremely cold winter, a very dry season, an increase in water salinity—you can study directly the effects of these factors upon the organism and determine whether the factors are limiting. On the other hand, the health or behavior of an organism can serve as an ecological indicator that an environmental change is taking place. Thus, if mortality increases markedly in an estuarine population, you are prompted to investigate whether the salinity, the chemical content, the temperature, the oxygen supply, or the turbidity of the water is changing.

Some organisms require different environmental conditions during different phases of their life cycle. For example, the eggs or larvae of animal species may be far more sensitive to changes than the adult organisms are. Seeds may germinate and sprout only when certain soil and moisture conditions prevail. The limiting factors which cause a marked increase or decrease in the number or condition of a species may sometimes be difficult to identify unless all stages of an organism's life cycle are considered.

There are several different terms applied to the place in which a species is found. An organism's habitat is the broader geographic area where environmental conditions the species can tolerate are found. But an individual organism or a family group usually restricts its activity to a definite area, its "home range." If it actively defends a specific area against invaders, especially during periods of nesting or raising its young, this area is its "territory."

An organism is also placed according to its niche. An organism's ecological niche depends not only on where it lives, but also on its function in the community. To understand an organism's niche, we must know its sources of energy and nutrition (its role in the food chain), its metabolism and growth rates, its effect on other organisms with which it comes into contact, the seasons in which it is active, and how much it can modify its environment.

Scientists believe that, in the long run, only one species can occupy a specific niche or play a specific role in the ecological community; if two species compete for one role, one will eventually be driven out. This does not mean that very similar species, among birds for example, can not occupy very similar niches. Interestingly enough, scientists have found that different species occupy nearly identical niches in ecological communities in different parts of the world. These species, which have developed to perform certain functions in the ecological community they belong to, are called "ecological equivalents."

Hopefully these general ecologic concepts will help you understand what the organisms you observe in the outdoors are doing, why they live where they do, and how they interact with other organisms around them. These ideas should help all of us realize that the lives of the plants and animals we see have a purpose. If we recognize the environmental conditions that promote stability and productivity for different species, then we can protect or use natural resources in a way which will minimize Man's adverse effects on ecological inter-relationships.

Animals

Do you hear any animal sounds? A singing bird, a croaking frog, the rustling of branches all tell you when animals are near.

What are the sounds that you hear? What animals do you think are making these sounds?

Can you find any traces of animals? Look for tracks, droppings, nests, bits of hair, bones, and burrows.

Do you see any animals? What are they?

Use a poem, a cinquain, sketch, or a story to tell about one or more animals you have seen or suspect to be living in this place.

List all the animals and animal traces you find in this place.

Findings

Animals seen (name or sketch)	Description

Animals heard (name or sketch)	Description of sound

Animal traces seen (describe or sketch)	Animal you think left trace

Of the animals you have seen or have found evidence of, choose one and try to discover all you can about it. Put yourself in the animal's role. What would you eat and where would you find your food? Is there a danger that another animal might eat you? What animal would that be? Where would you go for water? Where would you take shelter from danger? How would the changing seasons affect your life? Write a story about how you would feel as that animal living here.

To locate the homes of animals here, look high and low. Almost every place in Nature provides a house for some animal. Be careful not to disturb these homes when you look. Make a list of the homes you find here and their inhabitants.

Kind of home	Inhabitants	Reason they choose this home

Can more than one kind of animal live in the same home? If so, does one animal help the other, do they both help each other, do they compete, or what? Describe some of these inter-relationships which you can see or have learned about in the past.

Do you know some animals that defend their homes, or the territory around their homes? If so, describe these animals, their enemies, and how they protect themselves.

Do all animals spend their whole life in one home? If you know some animals that move during their life, think about the distance they travel to find a new home, and why they move around as they do.

Think about the seasons in this place. Do weather changes during the year affect the animals? How do some of the animals here protect themselves from bad weather, or take advantage of good weather?

How do you think Nature helps the animals here to detect danger?

Do you think Nature helps the animals here to hide from danger? How does it help?

Think about the foods animals eat. Do some animals have to go farther than others to get food? Describe some examples of food gathering that you know.

Think about factors that affect the amount of food available to animals. Does the number of animals in this area affect the food supply? How?

What effects does climate have on the food supply?

What effects do Man's activities have on the food supply?

Do most of the animals you know eat more than one kind of food? Could this help them survive if the supply of some foods is short?

Now that you have investigated some of the basic needs of animals, do you think this place can support a large number of different kinds of animals? Why or why not?

What do you think is the biggest animal living here? The smallest?

Do you think the same animals are living here now that lived here 10,000 years ago? 1,000 years ago? 100 years ago?

Have some of the animals which no longer live here become extinct? ____________________
If you think so, list some animals you have heard of which are now extinct.

Why do you think animals become extinct?

Possible reason because of Nature	Because of Man

Do you think the animals that live here now will be living here in 1,000 years? In 100 years?

If you think some of them will be gone, why will this happen? Try to think of several reasons.

Some of today's animals are in danger of extinction. Do you know about any of these rare or endangered species? Do any of them live in your area or in your state?

You can find out about these endangered species by contacting your state game or fish commission or the Bureau of Sport Fisheries and Wildlife in the U.S. Department of the Interior. (The addresses for this and other conservation organizations appear in the Appendixes on Page 126.)

In what ways are animals important to you? In what ways are they dangerous or destructive?

Important to Man	Danger to Man

Use a poem, a sketch, or a story to show what it is about animals, or a particular animal, which interests you most of all.

Try to visit a zoo or park where animals are kept. Make comparisons between the ways animals live and behave in captivity and in the wild. What do you think would happen to zoo animals if they were suddenly released into a natural area?

What do you think would happen if an animal from the wild were transported from one natural habitat to another similar one?

If your class is interested in the protection and management of wildlife, perhaps you can organize a simulation game to investigate a problem such as the following:

The Problem:

> A rancher raises a large number of cattle for a living and grazes these cattle on a large acreage of land. He discovers that some wolves have killed several of his cattle in a faraway pasture. In his state, predators such as wolves are not protected by law. Therefore, the rancher tells his workers to shoot any wolves they see on his property. Some of the other ranchers agree with him that these predators must be controlled, but the rancher is criticized by other people in town, especially the members of several conservation organizations. Many local hunters become involved in the argument, too. An official of the state fish and game commission is asked for his opinion. Several local newspaper reporters want to write articles describing the facts of the situation.

The Players:

1. The rancher: This rancher makes a living for himself and his family by raising and selling beef cattle. To raise good cattle he must make large investments in buildings, equipment, cattle feed, and pasture improvements. He must run a very efficient business each year to make a living. The rancher does not want to kill wolves needlessly, but the loss of even a few cattle is a serious business loss.

2. Other ranchers: They too, depend on cattle-raising to earn their living. They would be unhappy if the law prohibited them from killing wolves and other predators which endanger their cattle in the future. They do not want non-ranchers interfering with a practice which takes place on private property.

3. State fish and game commission officials: These officials work for the state government. The state legislature has been discussing a law to protect certain predators, but so far no law has been passed. These officials have talked a lot in the past with ranchers, conservation groups, and hunters about the predator problem. They believe that predators are part of the ecological balance of Nature, but they recognize the ranchers' problem too.

4. Conservationists: Several people in the community belong to state and national conservation organizations. They believe that the shooting of many wild animals should be forbidden. Some of them are specifically concerned about protecting wild animals that are sought only for their fur pelts and not for food. They are very concerned about protecting the ecological balance of Nature.

5. Local hunters: These people may or may not share the ranchers' reasons, but they agree that predators should not be protected by law. The hunters want to be free to hunt all wildlife including predators. They believe hunting fits in with the natural life and death cycle of the ecological community.

6. Newspaper reporters: The reporters know that there are facts and opinions behind both sides of this controversy over predators. The public is concerned about the issue and, because passage of a state law to protect predators is possible, they want to become better informed. It is the reporter's job to present the facts about the issue as clearly and accurately as possible for the community.

Procedure:

Divide the class into the various groups. Each group should meet and discuss the most important points they will present to the newspaper reporters. Their ideas should be based upon some research into the problem, not just personal opinion. Each group should elect a spokesman to present its ideas to the newspaper reporters at an interview. After listening to the representatives, the reporters should try and summarize the arguments, as they would to prepare a newspaper article. Your class may wish to invite an employee from the game and fish commission or a resource management agency to meet with you and discuss your ideas.

Conclusions:

What reasons in the predator controversy did your class think were the best? Why?

What is your own opinion about the predator controversy described above?

Now that you have enjoyed many different parts of the environment and learned about them, try putting these parts together into one big picture. Think about one of the important natural areas in or near your town.

Do all the parts work together to create a pleasant, healthy environment? If some parts of the environment could be improved, what should be done?

Take another look at the Web of Life on Page 75. The animals depend on plants, sunshine, air, water, and soil for survival, as you have seen. What things in nature do you depend on?

All over the United States and in the rest of the world, people must have food to survive. Think about the food-getting problems of animals you have discussed. What kinds of problems do some people have in getting enough food?

People in every place need a home or shelter, too. What different kinds of shelter do people need in different parts of the United States? In different parts of the world?

Do people in some places have a difficult time finding the shelter they need? Why?

Do people defend their homes or territory against enemies? Why is it necessary to do this?

In some environments there are conditions the animals there have adapted to. The animals have developed physical features or abilities which help them to survive. Are there conditions in Man's environment that he must adapt to? Name as many as you can.

In what ways is Man able to adapt to his environment?

Are there some conditions in the environment which Man cannot adapt to very well? Name as many as you can.

If some unhealthy conditions exist in your environment, do you need more information about them? What places and people could you go to for this information?

Is there a serious problem in or near your community which needs immediate attention? If so, describe it as well as you can and tell why it is important to you.

What do you think should be done about this problem?

Is it important to get other people and students in your community interested in this problem? How can you get them interested?

Are there people in your community working on this problem? Who are they? (If you do not know, try to find out by reading a newspaper or talking with people who know about the problem.)

What are these people trying to do about the problem?

What could you and your class do to help solve this problem? What could your family do?

Appendixes

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When we study the inter-relatedness of all living things in the environment, it is easy to see that Man is influenced by his environment, and that he has many effects on it, too. Some of the effects of Man's activities, such as the use of DDT and atom bomb testing, have long-range, worldwide effects; these effects suggest that the whole world has become each man's environment, and that international regulation and cooperation will be necessary to protect and improve the world environment.

As human beings, we need to examine our relationship with our environment now. What environmental needs do we have today? Do you think that these needs can be met without taking more energy and more resources from the ecosystem than we should? If it looks as though Man must take more from the environment then it can spare, what can Man do to reduce the adverse effects he may have on the balance of Nature?

Something else we learn from the environment is that we human beings have needs and require certain living conditions, just as plants and animals do. But Man has been able to adapt himself to a greater range of environmental conditions than most organisms. All the developments of the human mind and technology help him survive extreme temperatures, withstand diseases, communicate over long distances, travel all over the earth, and obtain food and shelter. His adaptations or inventions are complex, they utilize many natural resources, and many of them fulfill Man's wants beyond his basic needs.

At this time we need to determine whether the short-term benefits we want now are as important as some long-term environmental losses we may suffer in the future. Maybe we are paying too high a price for today's comforts. Maybe we need to establish priorities for the treatment and use of natural resources; accomplishing really significant shifts in our resource consumption would require the cooperative effort of all individuals and institutions.

By studying ecological relationships, we can learn a lot about our relationships with other members of the human population, too. Ecological study may help us to realize that all individuals have basic needs for survival, and to think about the things each individual really needs. Since we are all inter-related in the same environment, the way each of us acts affects the lives of others. The way all of us use our skills and use earth's resources influences the kind of environment we will live in. Hopefully environmental education can help people learn more about their relationships with their surroundings, and motivate people to act in a way which promotes harmony between Man and his environment.

There is a balance of relationships among organisms in the environment. Man is definitely a part of the environment; he has "mastered" the environment, or so it seems right now, to such an extent that we tend to think everything in the environment exists for Man's benefit and use. Is the environment important because of its support for Man and his activities, or would the environment on this planet have its own value even if Man were not here? This is a difficult question; no one seems certain that one answer is correct. But what do you think?

VOCABULARY

basic ingredients:	the essentials needed to support life.
cinquain:	a form of poetry usually consisting of five lines which describes how a person feels about a certain subject.
collage:	a picture made from pasting objects or clippings dealing with one subject onto a sheet of paper.
ecology:	the field which deals with the relations between living organisms and their environment.
ecosystem:	the system of ecological relationships present within a given community.
environment:	surroundings.
food chain:	a series or chain of plants and animals which depend on each other for a food supply; for example, algae → shrimp → fish → man.
inversion:	a condition in the atmosphere which occurs when a warm layer of air is trapped between two cooler layers of air.
life support system:	everything needed to maintain life.
mapping:	making maps; locating objects in relation to a known point.
net of interaction:	all living things and how they affect one another.
noise:	unwanted, disagreeable sound or sounds.
ppm:	parts per million; used to describe the amount of available oxygen in water.
pH:	how acid or alkaline water or soil is.
pace:	the distance a person travels with each step he takes.
plane table:	a flat surface on which to draw.
pollution:	discharge of waste materials which causes adverse and unpleasant effects to water, air, animals, land, and people.
population:	all the people living in a certain area; also all the living things in a certain area, such as all the animals in one place.
population density:	number of people per any given area of land.
raw materials:	unprocessed materials as they come directly from the land.
site:	the place where something, such as a town, is located.
urban:	of, in, or comprising a city or town; not necessarily a large town.
Web of Life:	all living things and how they depend upon one another for survival.
zoning:	dividing the land area of a town or city into sections restricted to specific types of use and construction.

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